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THE UNIVERSITY OF TORONTO MEDICAL JOURNAL

(An Undergraduate Publication)

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Vol. XIV Toronto, March, 1937 No. 5

A Plea to Graduates-elect.

We are entering a momentous epoch of our lives, for, within the next few years we shall determine the sphere in which the most important part of life will be spent. Therefore, it would be wise for us to consider deeply certain basic principles which decide the happiness and usefulness of life.

We are all interested in human beings, otherwise, we should never have chosen this profession. Many of us are interested in the natural sciences in other various aspects. We cannot learn too much about the principles of natural science and especially of human sciences—namely, philosophy (including religion), psychology, and psychiatry—in order to make life most enjoyable and useful.

It is certain that we shall consolidate our knowledge of medical science and art and their practical application within the next few years and most of us will keep fairly close behind the genuine advancements. But, unfortunately, there will be a much greater tendency during the hectic future to become narrow-minded and focus too great a part of our attention on medical science and practice. The only antidote for such failing is the return to some measure of our eager mental attitude of adolescence when we had a consuming interest in general knowledge, probably with especial emphasis upon the biological and human sciences.

In Memoriam — J. Edgar Bates, B.A. (McM.), M.D.

It was with a deep measure of sorrow that we heard of the death of Dr. J. Edgar Bates, of the Department of Pathology.

A graduate in Arts of McMaster University and in Medicine of the University of Toronto, Dr. Bates in addition to his teaching appointment, was Ontario Government pathologist and an eminent member of the Pathological Societies of Great Britain and of the United States.

Dr. Bates passed away suddenly on Sunday, February 21st, at 41 years of age.

To those who survive him we extend our sincere sympathies.

If one does this, the practice or study of medicine should become a much more pleasant work with the sharpness removed from the sting of discouragement and failure. The doctor can become a great influence in his community, for, of all the professions, his permits the best balanced combination of knowledge and interest in fellow-men and freedom from the various prejudices which beset so many of us.

The practical application of the above principles is very difficult indeed, but eminently worth while. In the selection of the type of work following graduation one should do what one likes best, regardless of financial or other return (compatible with earning a living, of course). No one can tell which road will lead to the greatest heights of fame or fortune but the field in which one's interest is keenest will likely yield the greatest results. It is certainly impossible to set any limit upon what may be accomplished by a man through his influence upon those he meets. If one has sufficiently broad interests and knowledge one can meet thoughtful people upon a plane of mutual interest, and life becomes immensely more stimulating for all parties concerned. Since the doctor is better educated than many of his patients and friends, he should strive to continue to educate himself so that he can attain sufficient mental mobility to initiate the delightful friendly relationship which may then grow spontaneously. Incidently, this will be of great therapeutic value and raise one's relationship with one's patients from a business to a friendly plane.

One should have broad, intelligent, but firm opinions upon all the great problems of mankind and it is quite possible that a doctor would reach his greatest usefulness in the House of Commons or as the local Medical Officer of Health.

J. P. F.

In Memoriam — William Gallie

On behalf of the student body we join the large group of friends and admirers to express to Dean Gallie our sympathies in the loss of his father.

OPPORTUNITIES FOR LEARNING SURGERY IN THE SURGICAL OUT-PATIENT CLINICS

R. I. HARRIS, M.C., M.B., F.R.C.S. (C.)

A wealth of material valuable for surgical teaching and training is to be found daily in the Surgical Out-Patient Clinic. There you will find aspects of surgery which you cannot see on the Wards and as these aspects and phases of surgery are the commoner kinds met with in practice, it is wise to cultivate them assiduously.

Your curriculum in surgery is planned as follows. In the fourth year you are taught: 1. the essentials of the examination of a surgical patient; 2. certain fundamental pathological problems such as inflammation, gangrene, and ulceration; and, 3. a brief survey of such surgical conditions as hernia, fractures, and dislocations. In your fifth year you cover more or less completely the whole field of surgery in a series of four clinics weekly. In your final year, possessing a rudimentary knowledge of the whole field of surgery. you become a small but important unit of the surgical staff and play a part in the management of the surgical wards and clinics.

It is in the fifth year, perhaps, that the Out-Patient Department offers opportunities which are least made use of. In the fourth year the necessary fundamentals can best be taught on the ward. In the sixth year, for ten weeks, you become a part of the surgical staff and in that capacity share the activities of your surgical unit on the ward and in the clinics. In the fifth year your ultimate success will be measured by the extent of the surgical field you have covered; provided always that your knowledge is accurate and thorough. The Out-Patient Department provides many opportunities for broadening your field of experience.

The opportunities in surgery which the Out-Patient Department is peculiarly suited to provide are these.

The opportunity to see a number of different surgical problems in a short time is afforded. In the hour alloted for a fifth year clinic from four to six patients can be seen and the problems of diagnosis briefly but succinctly discussed. To benefit, a student must possess a certain background of surgical knowledge and must be prepared to help the clinician. There obviously is not time for a detailed exposition of any one subject. Yet a vast amount of knowledge can be obtained and stored away if the student will come to such an Out-Patient Teaching Clinic alert, prepared to examine critically all that is shown him, and prepared to ask questions which will clear up any doubts or uncertainties he may have. There is a great advantage in cultivating this enquiring attitude of mind. Too often you reach your fifth year and indeed your sixth year with the mind of a high school student; a receptive but passive sponge, prepared to absorb all the information which is poured into it. This may be due partly to our necessarily crowded curriculum but it is a poor attitude with which to enter the practice of medicine. Once you commence to practise medicine your success is in large part dependent upon rapid and accurate judgment. You will find few places in the hospital better fitted to train this mental quality than the Out-Patient Department, where many patients must be seen in a short time, an accurate diagnosis made quickly and treatment or disposition expediently arranged.

Much of surgery, (and this by no means the least interesting part) is a craft, and like all crafts it can only be learned by experience (doing, seeing, feeling). To be a surgeon you must first have been the apprentice of a surgeon. Here the Out-Patient Department can be of inestimable value

to you, especially in the field of diagnosis. One glance at certain surgical conditions is sometimes sufficient to enable you to recognize the same condition forever afterwards. Thus to see a case of actinomycosis or a carbuncle or a carcinoma of the breast is of more value to you than to read all the descriptions of these diseases in all the surgical text-books that ever were written. No word picture, vividly as it may be painted by your most eloquent clinician, can conjure in your mind as clear a mental image as the memory of such a case once seen by yourself. I well recall the excitement aroused in my student days by the diagnosis of a case of leprosy. After weeks of study in the wards of this hospital, it was recognized instantly by a physician who had seen leprosy before. That revered teacher, Alexander McPhedran, was a master of teaching by observation. Vividly as though it were yesterday, I can recall a clinic in the Lecture Theatre to which he brought an hysterical patient who was subject to epileptiform seizures and so managed his discussion of the subject as to precipitate a convulsion before our very eyes.

Only the major surgical problems are admitted to the wards. The minor problems are dealt with in the Out-Patient Department and yet these problems will probably constitute the numerical bulk of your practice. If your teaching is confined to the Wards you may never have an opportunity to see ingrown toe nails, varicose veins, haemorrhoids, sprains, simple wounds, or sebaceous cysts.

A further advantage of the Out-Patient Department is that it offers you one of your few opportunities to see patients when they first come for treatment. There you will see patients whose complaints are still fresh in their minds, patients who are not wearied by the repetition of their story to internes and students. The problem is new and fresh and you can tackle it with all the interest associated with an unsolved puzzle.

APPLICATIONS in writing will be received until April 15, 1937, for the following positions on the staff of the University of Toronto Medical Journal for the year 1937-'38.

FEATURE EDITOR—'38.
ASSISTANT EDITORS—'39, '40. B. & M. '38.
WOMEN'S EDITOR—'38.
CIRCULATION MANAGER—from any year.

Address communications to the Associate Editor,
Room 107, Anatomy Building

THE DIAGNOSIS OF EARLY TUBERCULOSIS*

By HAROLD PARSONS, M.A., M.D., F.R.C.P. (Lond.)

I feel like offering an apology for writing on the early diagnosis of tuberculosis so often discussed, so I think it would be better if we spoke of it as the diagnosis of early tuberculosis. It is not so much actually the first evidence of tuberculosis, but the evidences of activity that we meet. In many supposedly early cases of pulmonary tuberculosis it is found by present methods that there is an older lesion demonstratable and that the condition as it shows itself at this time is not so much recent disease, but an activity implanted upon an old lesion. For instance, take the case with flattening on one side, impaired resonance on the same side, altered breath sounds, prolonged expiration. These in themselves are testimony that there is fibrosis, and that fibrosis is the result of former disease; and how often do we find that the X-ray shows in addition to the fibrosis, a pleural cap which also speaks of the same thing. Now when moisture on auscultation is added to this picture we realize that we have activity. So that in many of our cases, our so-called diagnosis of early tuberculosis is really activation of a former lesion rather than the actual beginning of the disease.

There is an extraordinary amount of latent tuberculosis which people carry about with them, that gives no signs or symptoms and naturally passes unnoticed. It is our duty as physicians to be on guard to pick up any evidence of activation, for that is the beginning of trouble. This is where lives are saved or lost.

Since the examination of contacts was instituted we are, I think, really seeing initial infections. Take the following instance: A young woman, 19 years of age, recently exposed to an open case of tuberculosis is brought for examination. She appears well, and insists that she is well. Her examination is quite negative. There are no physical signs. Her tuberculin test is positive, and X-ray shows a small puff of soft shadow in the left upper lobe. Suitable care is given this girl, and after 18 months in Sanatorium the X-ray shows a small clear-cut nodule in the site of the former soft shadow. It has all the characters of a healed tuberculosis lesion. That we think, is a case of recognition of the earliest evidence of disease.

When the study of contacts was first introduced it was thought that only children were our concern, and it was freely stated so. But some of us felt differently and thought it applied to adolescent and early adult life as well, and subsequent experience has fully justified that idea.

The examination of contacts includes the history of exposure, a physical examination, and I think you will agree that in most of the cases we find no physical signs. A tuberculin test is made. If it be positive we know that there has been infection, but be it understood that that infection may not apply to the history of exposure which has been so recent, but it does show in any case that infection has occurred and it puts us on our guard. It is probably a childhood infection which the X-ray will reveal. If, on the other hand, the tuberculin test be negative, it is all to the good, but it must be remembered that with a history of recent exposure it must not be too definitely relied upon, simply because we do not know how long after infection it takes any one individual to develop his or her sensitiveness to tuberculin. So that it is well to repeat the tuberculin test within the next two or three

*From Chest Clinics of Toronto General Hospital, and Hospital for Sick Children, Toronto.

months. As I say, we do not know how long after exposure sensitiveness to tuberculin is developed by any one individual. The shortest period of time we have ever seen is 7 weeks in a child, but that, we feel, is exceptional. Three, four, or five months is more usual. Could we be sure of the date of infection in a patient as we are in an inoculated animal, we could speak with more confidence. In a contact which is tuberculin positive and without physical signs, the X-ray of course is of the greatest possible value. There may be a great deal of tuberculosis present in the body without physical signs or symptoms. This has special application to children. When we find in such a case dense nodules at the hyla of the lungs, with or without a primary focus out in the lung, we are dealing with a childhood infection. It is enough to give us our positive tuberculin reaction but it probably does not have any relation to recent exposure. It may be a thing of many years' standing. There may be no cough and no sputum so the laboratory will not help us. The clinical observation of the temperature, pulse and respiration is of great help, and in these young contacts do not forget the patient. What does he or she show? Age is very important. The period from 16 to 25 years of age is of the utmost moment. The presence of fatigue or loss of weight, all these points may be of value in judging of the onset of the acute disease.

Now is this a reactivation of a childhood disease or is it a re-infection? That is too long a matter to discuss here. Undoubtedly we have examples of both, but I feel that the re-infection is the more important.

The mode of onset of pulmonary tuberculosis varies a great deal. Young women often first complain of indigestion, fatique, and loss of weight. Cough and sputum, and other signs suggestive of pulmonary disease are often wanting. Afternoon temperature may be present. In fact, the onset in the first place may have few symptoms which suggest disease of the chest. In another type we find a history of repeated coughs and colds, and the parents or the family state that this disease began as a neglected cold. If you look into the facts of the case you will find that for several years this patient has had a winter cough, which clears up in the summer, only to return the following winter. There is every reason to believe that each one of these coughs and colds to which they refer is a slight invasion by tubercle which recovers with better climatic conditions, also with more out-door life. We know that tuberculosis is essentially a disease of exacerbations and remissions. It is also a disease which, if it gets a fair chance, tends to heal itself. Hence this history of repeated coughs and colds is a very important one. At last this patient has an attack of greater or less severity which continues and fails to clear up, and it is found that there is a definite focus of disease.

A history of pleurisy is of great moment. The so-called idiopathic pleurisy is, in the great majority of cases, tuberculous and the proof of this is becoming stronger all the time. Exactly the proportion of cases of pleurisy that later develop pulmonary tuberculosis is not known. It has been stated that 30% or 40% of the cases with a history of pleurisy subsequently develop clinical tuberculosis but the figures vary considerably. But a history of pleurisy in a case of suspected tuberculosis must carry with it very considerable weight.

Hæmorrhage from the lungs is in quite a large number of cases the very first evidence of anything wrong. It comes like a bolt from the blue in a person who is apparently quite well. At one time it was thought that hæmoptysis was over 90% tuberculous but I think that these figures must be revised, judged in the light of more recent knowledge acquired regarding non-tuberculous disease. The spitting of blood always suggests tuberculosis. It is always suspected that that case is tuberculous and it is looked upon as

such until a satisfactory denial is forthcoming. We have to think of hæmorrhages from the gums, from the throat and nasopharynx, and we must think of the possibility of heart disease, especially mitral stenosis; and most of all must we think of bronchiectasis. The recently acquired knowledge with regard to the development and behaviour of bronchiectasis both in adults and children makes us realize that it can account for a great many of the cases of hæmorrhage from the lungs. In any case of this kind everything should be done to exclude tuberculosis before it is labelled anything else; and everything else must be satisfactorily excluded before a diagnosis of tuberculosis is fixed upon.

Many a tragedy has resulted from taking hæmoptysis too lightly. A young working girl coughed up some blood in August. Her physician told her it was from her teeth, and she and her mother were much reassured. In October again, she brought up some more blood, but the mother and she assumed that the cause was the same —and you know people sometimes do believe what the doctor says, and especially when it is the easy way out. The following February that girl was brought to the clinic with a bilateral tuberculosis with cavitation, in a perfectly hopeless condition.

When we are unable to find a satisfactory explanation for blood-spitting, it is well to observe the patient for a period of time. The difficulty of finding the exact spot from which the blood came is at times very great. A case will illustrate this point: A man was stooping down to tie his shoe before going to his work; he had been perfectly well as far as he knew. During the day he had several recurrences of the hæmorrhage. I was unable to localize the source of the trouble, either on examination or with X-ray, or with other means available. He was sent to Sanatorium and only after 4 months was a small focus found in the lung, and eventually tubercle in the sputum. And for that reason I say that any questionable case must be observed for a considerable period of time.

Now apart from these forms of onset we have at times a very acute outburst of tuberculosis. The patient is acutely ill with sudden onset; temperature is 102 to 103; pulse corresponding, 120 to 130, and differential diagnosis is sometimes quite difficult. Let me state a case: A nurse on duty is taken ill, with temperature of 102, malaise, although no cough or sputum —nothing to suggest anything wrong in the chest. White blood cells were 6,000; typhoid fever was suspected; Widal reaction was negative. X-ray showed a filmy shadow out from the hylum of the left lung and some caseous glands could be noted at that hylum. Later, the fact was revealed that this young woman's mother had died of pulmonary hæmorrhage four weeks after the birth of the patient. Artificial pneumothorax was done. Tubercle were soon after found in the sputum. This, I take it, was an acute re-activation of a childhood mediastinal tuberculosis, such as we see in children but rarely in adults. In another instance, a young man of 20 years of age with a similar picture; sudden temperature; none of his symptoms or signs had any particular reference to the chest. The white blood cells were 6,000; Widal reaction negative. There was acute and rapid invasion of the right lung and tubercle bacilli were found in the course of ten days.

Sometimes in the midst of an epidemic of influenza, so-called, a case like this is met: A young person has fever, temperature 101, some general bronchitis, and in this particular case in the left upper lobe was an area with bursts of fine moisture. This area of moisture persisted and was found to be a definite area of pulmonary tuberculosis apparently lit up by an acute respiratory infection. At any rate, she was quite unconscious of having had any chest condition before. There is another type that sometimes arises— that of an acute tuberculous pleurisy. A nurse on duty develops malaise; no

cough, but fever to 102 degrees. There is a gradual development of fluid in the right pleural cavity. Examination of the fluid reveals tubercle bacilli. She has made a good recovery; I mention it just to show the various and unexpected ways that the disease will appear and how it mimics other acute diseases.

There is a tendency to be content with one proof of the existence of tuberculosis. Of course positive sputum is very definite, and the X-ray picture may be very convincing but this sort of medicine is not entirely satisfactory. We must know of what has led up to it. And this we get in the history. Cases come to us which look like comparatively recent ones, but the history may show that three or four years' illness may have been the fore-runner. In many cases there have been so many laboratory reports and so much X-ray report that the patient is almost overlooked. What does he or she show? How is she? Has there been any change in her weight? Are her temperature and pulse normal, particularly the pulse? What is her age? And with regard to age, how well elderly people stand it, and often how poorly the young.

Diagnosis is important, but prognosis is a point on which the patient and the patient's family insist. What is the outlook? This depends on the history and on the period of illness. How has he stood the strain? How many relapses has he had and how did he handle them? What is his effort tolerance? These are points of interest and it is only on the examination of the patient and the gaining of all available information that the case can be properly assessed. No one appreciates more than I do the value of the X-ray and other accessory means of examination without which our work would be incomplete. On the examination of the patient there may be stigmata of tuberculous disease which are to us of the greatest import. Enlarged glands, or scars in the neck, any remains of surgical tuberculosis, corneal ulcers or opacities, they all tell a tale worth knowing. So let us view our cases from every angle, as in this way alone can we have a comprehensive understanding of our case.

The Out Patient Clinic is a wonderful field for work and I think particularly for the physician and the student in the field of tuberculosis. It is where we see the contacts. We do not see these on the ward to the same extent. It is the same in private practice also, and as all our work is in preparation for private practice it is well to have seen something of the study of contacts, and it is becoming more and more interesting, and I think of increasing value.

Again, the student in the Out Patient Clinic sees cases in the raw, if I may so use the term. They have a chance to work out their cases from the first; they develop an interest in their contact with the individual, and they have the opportunity of following that patient throughout his illness, into the various departments through which he or she may pass. I have noticed that a good many of the students do this. One case well studied and well followed up is of great value, of much more value than seeing many uncompleted. The work on the Ward is the finished article, with all the refinements of investigation which cannot be well carried out in the Out Patient Clinic. It is the last word in investigation. But for the student in his earlier years, the Out Patient Clinic is a great training.

FACILITIES FOR POST-GRADUATE TRAINING IN THE BRITISH ISLES

By D. Y. SOLANDT, M. A., M.D., Ph.D. (Lond.).

The majority of medical students continue their formal training after graduation. In most cases one or more years are spent in general clinical work. Following this, some proceed into practice, others into some form of specialized clinical work, often leading to a fellowship or membership in one of the Royal Colleges, and a few undertake full-time research work. Toronto has excellent facilities for all these forms of post-graduate training. However, many feel that they should go elsewhere for at least part of their post-graduate work, and it is to this group that these few remarks are directed.

Canadians undertaking post-graduate work abroad usually go to the British Isles or to the United States. Those seeking hospital experience will find ample opportunity in either country. Travelling expenses are less to the States, but as compensation, it is easier for a Canadian to acquire and hold a paying position in a hospital in the British Isles. In both countries the person with only one or two years' hospital experience who requires a salary for his services will have to seek work in one of the smaller institutions. As distinguished leadership is such an important factor in the value of post-graduate training these small hospitals rarely serve the student as well as do the large teaching centres. On the other hand, the opportunities for obtaining unaided experience are often excellent in the smaller hospitals, and short appointments of three or six months are frequently granted. Indidiual hospitals differ to such an extent, and the services in the same hospital in many cases are so variable that it is advisable to obtain first-hand information from some person who is familiar with the institution in question before applying for an appointment.

There is probably no centre in the world offering such a wide variety of medical training as does London. The University of London directs the educational facilities of twelve hospitals as well as the British Postgraduate Medical School with its own associated hospital. The London area contains about one hundred other hospitals, some large and some small, some specializing in teaching and others with no teaching facilities apart from the clinical material itself. In neurology the National Hospital, Queen-Square, is world famous as a training centre. Less well known are the West End Hospital for Nervous Diseases with an annual out-patient attendance of 40,000, and the Hospital for Epilepsy and Paralysis at Maida Vale. Dealing with diseases of the heart and lungs are the Royal Chest Hospital, the Brompton Hospital for Consumptives and Diseases of the Chest, the City of London Hospital for Diseases of the Heart and Lungs, and the National Hospital for Diseases of the Heart. The Hospital for Sick Children, Great Ormond Street, is well known, and there are in the London area, five other less celebrated hospitals dealing with diseases in children. Seven hospitals deal only with obstetrics and diseases of women. Three hospitals are devoted solely to the treatment of cancer, four to ophthalmology and so on, each specialty being represented by a number of hospitals devoting all their resources to that particular branch of the healing science. In addition there are the big general hospitals under the direction of the University of London or the London County Council in which the fields covered are as diverse as in our own general hospitals.

The London Postgraduate Medical School at Hammersmith is unique in the facilities for post-graduate training which it provides. Although a new development, and one which has not yet attained to half its projected size, this school is already offering outstanding opportunities in clinical and laboratory training. Among the notable members of its staff is Dr. E. J. King, a former colleague of Sir Frederick Banting in the Banting and Best Department of Medical Research of this University. The Hammersmith school has as its object the provision of facilities for: (1) students from the Empire and abroad who desire post-graduate work in medicine, surgery, obstetrics and gynaecology and pathology; (2) newly qualified students preparing for higher examinations or specializing in one of the above branches; (3) graduate students who are given facilities for research; (4) refresher courses for general practitioners. Many of the other large hospitals in London and elsewhere have similar aims but in few, if any, has the hospital been developed primarily for this purpose and with these aims controlling the organization and equipment.

The hospitals of many other large cities in the British Isles offer splendid opportunities for those seeking further experience. Although not as celebrated as the London institutions, the hospitals of cities like Birmingham, Dublin, Edinburgh, Glasgow, Liverpool and Manchester are well and favourably known to medical men throughout the world.

Many graduates go to the Old Country for the expressed purpose of obtaining a higher degree, fellowship or membership in one of the Royal Societies, or a diploma from one of the specialist schools. Special courses preparing candidates for these examinations are given by a number of the hospital medical schools. Fees for these courses vary from approximately fifty to one hundred and fifty dollars. The majority of candidates devote at least six months to study, uninterrupted by formal hospital duties, before trying either the primary F.R.C.S. or the M.R.C.P. examination. As similar degrees are now granted, after examinations of similar severity, by the corresponding Royal Colleges of Canada, we can look forward to the day when valuable time abroad will not be spent in an attic memorizing text-books.

To those who plan to follow up their post-graduate training with a medical appointment in one of the United Services or in the Colonial Medical Services, the London School of Hygiene and Tropical Medicine offers courses which are invaluable, and indeed for most such aspirants, compulsory. This school offers a five-month course in tropical medicine and grants a Diploma in Tropical Medicine to successful examination candidates at the end of the course. Similarly a Diploma in Public Health is granted after a course of about nine months' full-time study. The work in this latter course is much the same as is given by our own Department of Hygiene and Preventive Medicine but the subject matter is not as well adapted to Canadian conditions and to problems which are peculiar to this country.

Further information on all these subjects will be found in the Student's Number of the Lancet, which is published each year in August.

So far we have dealt chiefly with the facilities for clinical and formal training in the various branches of medical science. Research constitutes a less stereotyped form of training and a training which continues as long as the research itself is continued. Here the training is largely one in methods of thought; therefore distinguished leadership, in the early stages at least, is invaluable. Again, this is an ingredient of our education which, fortunately, we can obtain without leaving Canada or Toronto. Indeed, the student will be better equipped to appreciate in its proper setting new methods of thought and of work if he has first absorbed the teachings of the scientists who have directed his undergraduate

training. Some training in the methods and thought processes of research is almost a prerequisite of admission to the laboratories of the outstanding scientists of other lands. Toronto students are fortunate in having at hand the facilities for complete training in research, a training which, if they show promise, will give them entree into almost any laboratory in the world. Admission to a laboratory for the pursuit of research is usually obtained through members of the local staff.

Cambridge, Oxford, the Colleges and the hospital medical schools of the University of London and the Hampstead Laboratories of the Medical Research Council offer the most outstanding research opportunities in both clinical and pre-clinical sciences to be found in the British Isles, and probably in the world. Men of world-wide reputation are to be found directing work of every conceivable type in this group of institutions. The fact that such a large number of research workers is congregated in so small an area encourages the exchange of ideas which is so valuable in any explanatory endeavour.

Many Canadian students undertaking post-graduate work in the British Isles expect to find living expenses less than in Canada. They have been sadly disillusioned. In most parts of England the cost of living is somewhat higher than in Toronto, and in London it is considerably higher than in the rest of England. The question of living expenses is not important to the person who travels from one hospital appointment to another, but to the research worker or to the person who is studying for some examination and who must pay for his "keep" they are of primary interest. Certainly not less than seventy dollars a month should be put aside for living expenses; this will cover few amusements and no travelling.

The University of London provides no adequate men's residences. Most of the students live in boarding houses in indifferent comfort. Canadians are more fortunate than the English students in having access to London House, an endowed men's residence run on the lines of a club and open to British subjects of white parentage from the Dominions and Colonies. This residence provides much more comfort than the ordinary boarding house for about the same charge. There is always a long waiting list, so it is advisable to apply for admission about six months before accommodation is desired.

Canadian students going to the British Isles for the first time will find it profitable to consult Mr. J. R. Johnston of Hart House. He has made a study of the facilities for education and living in the British Isles and on the Continent in view of the requirements of the Canadian student. During the winter months he can be reached through Hart House and for the rest of the year through Canada House, Trafalgar Square, London.

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THE INVESTIGATION OF RECTAL BLEEDING

By J. WALLACE McNICHOL, '37.

The discovery of the exact site of origin of rectal bleeding is always of importance, not only to the patient, but to the surgeon. To the patient, this means the mental peace that results from an adequate examination and accurate diagnosis; to the surgeon, it means that treatment can be adequately planned. When one realizes that a bleeding lesion lying anywhere between the mouth and the anus in the gastro-intestinal tract will give rise to this symptom, then the widespread possibilities become apparent.

It must be clearly stated at once that by no means does the following classification include all the diseases which can give rise to this symptom, but includes only those lesions which have some definite surgical importance:

Classification.

A—OBVIOUS RED BLOOD PASSED PER RECTUM.

1. *From anal causes.*
   - (a) hemorrhoids.
   - (b) fissure in ano.
   - (c) fistula in ano.
   - (d) foreign body.
   - (e) condylomata.
   - (f) anal carcinoma.
2. *From rectal causes.*
   - (a) carcinoma (primary).
   - (b) polypus (benign).
   - (c) polypus (malignant).
   - (d) tuberculous ulceration.
   - (e) invasion of rectum by:
     1. vesical carcinoma.
     2. uterine carcinoma.
     3. pelvic carcinoma.
     4. pelvic abscess.
     5. actinomycosis.
   - (f) infective proctitis.
   - (g) injury to rectum.
3. *From colonic causes.*
   - (a) carcinoma, primary of:
     1. sigmoid.
     2. descending colon.
     3. splenic flexure.
     4. tranverse colon.
     5. hepatic flexure.
     6. ascending colon.
     7. caecum.
   - (b) Chronic diverticulitis.
   - (c) Acute diverticulitis.
   - (d) Polypus of colon.
   - (e) Tuberculous ulcers of colon.
   - (f) Intussusception.
   - (g) Benign tumour—lipoma.
   - (h) Ulcerative colitis.
   - (i) Thrombosis of mesenteric vein.
   - (j) Embolism of mesenteric artery.
   - (k) Injury.
     1. Abdominal.
     2. Per rectum.
   - (l) Idiopathic mucous colitis.
4. *From Ileal causes.*
   - (a) Intussusception.
   - (b) Typhoid fever.
   - (c) Thrombosis.
   - (d) Embolism.
   - (e) Meckel's diverticulum.
   - (f) Injury.
5. *From Causes in Jejunum.*
   - (a) Peptic ulcer (very rare).
   - (b) Stomal ulcer after gastric jejunostomy.
6. *From General Infection or Allied Causes.*
   - (a) Typhoid fever.
   - (b) Scurvy.
   - (c) Henoch's purpura.
   - (d) Amoebic dysentery.
   - (e) Lympho-granuloma inguinale.

B—MELAENA.

1. *From Duodenal Causes.*
   - (a) Simple ulcer — neg. Benzidine (6 weeks after attack very frequently occurs).
   - (b) Injury.
   - (c) Carcinoma (very rare).
2. *From Gastric Causes.*
   - (a) Injury.

(b) Ulcer.
(c) Benign polyp.
(d) Carcinoma.
(e) Sarcoma.

3. *From Esophagus.*
   (a) Esophageal varicoses (related to cirrhosis of liver).
   (b) Esophageal carcinoma.
4. *From swallowed blood due to*:
   (a) Epistaxis.
   (b) Hemoptysis.
   (c) Fracture of base of skull.

In Melaena. (Black blood producing tarry stools) the following are the *Commonest causes*:

(a) Gastric ulcer.
(b) Duodenal ulcer.
(c) Gastric carcinoma.
(d) Cirrhosis of liver.
(e) Swallowed blood derived from:
   1. Epistaxis.
   2. Hemoptysis.

It is wise to remember that melaena may be simulated by various drugs and foods, thus the exhibition of bismuth, charcoal and iron may be responsible for black coloured stools. The eating of beets may produce sufficient red colour in stools to suggest haemorrhage from a source low in the gastro-intestinal tract.

Diagnosis.

It is very well advised in attempting to solve any problem of differential diagnosis to develop a definite workable, all inclusive system; and to use this system in the solution of every problem which confronts one. The following is highly suitable for the conditions:

1. History.
2. Physical examination.
3. Laboratory examination.
4. Sigmoidoscopic examination.
5. Barium enema.
6. Barium series.
7. Exploratory laparotomy.

HISTORY.

The patient's account of his symptoms is of comparatively minor value from a diagnostic point of view but yet has a very definite place. It cannot be too strongly insisted upon that a digital examination of the rectum should always be made when symptoms of rectal trouble are complained of, and that by no means should a case be treated for rectal symptoms without an examination. The most important symptoms are increasing constipation, indicating partial obstruction of the large bowel.

So frequently does one find hemorrhoids and fistulae existing with and usually the result of, cancer higher up in the rectum that, unless this rule is adhered to, many cases of cancer will be missed in the early stages when treatment can be successful. It is, however, always advisable to spend some time in going carefully into the history and symptoms, for, although the information obtained is not of as much value as one might believe, yet the time so occupied allows the surgeon an opportunity of estimating the type of patient with whom he has to deal, and of obtaining his confidence; while it enables the patient to shake off the not unnatural nervousness induced by walking into the surgeon's consulting-room. If it is pain he complains of, inquire into its character; sharp, knife-like, dull, aching, whether it keeps him awake at night, or whether it comes on after the bowels act. If blood; the amount, bright red or dark, beginning of stool, throughout stool or just at end of stool, mixed thoroughly with faecal contents or just on the surface of stool, accompanied by pain, associated with or without mucus or pus. Also inquire into duration of symptoms and ask what it was which first drew the patient's attention to the condition. One must not be lead into the pit-fall, that because the symptoms are trivial, the disease is the same. Even though the symptoms of rectal disease are so varied, and differ so widely in various cases, there are nevertheless, certain symptoms which should always be most carefully investigated, since they might be the result of malignant disease in

some portion of the bowel. It must be remembered that malignant disease cannot be excluded just because the patient is young, since rare cases of malignant disease of bowel occur in the teens. The symptoms which should put us on our guard, and which lead to a most careful investigation are:

1. The sudden onset of constipation without obvious cause.
2. A history of alternating diarrhoea and constipation.
3. Attacks of colic at frequent intervals, which can only be relieved by large doses of aperients.
4. The sudden onset of hemorrhoids, especially in an elderly person.
5. Morning diarrhoea.

This last symptom may indicate the presence of some lesion either in the rectum or sigmoid flexure, the commonest cause being ulceration or some other inflammatory manifestation within the rectum. It may also result from structures, either simple or malignant, and when this symptom is complained of, the surgeon should make a careful investigation to ascertain the cause.

Occasionally it is known that severe rectal bleeding may be caused by high blood pressure, probably over 250 in an elderly person who has no other positive symptom or sign.

A rather rare cause indeed of severe intestinal haemorrhage may result from a Meckel's diverticulum and the cause may prove very difficult to detect. Nevertheless this should be kept in mind after all other etiological factors are exhausted. The history of such a case is that a patient has had a number of almost fatal intestinal haemorrhages at very infrequent intervals with completely negative physical examination, no blood disease and normal mucous membrane in the bowel. At laparotomy, a Meckel's diverticulum is found, the end of which frequently contains ectopic gastric mucosa and in which is a peptic ulcer. The removal of the diverticulum entirely cures the patient. Two such cases have been reported, one by Lockhart-Mummery in a girl 25 years of age and the other by Clarke in a girl 8 years of age.

After the patient has been thoroughly examined, the history of the case should be carefully studied with the object of explaining the findings and for confirmatory evidence. One must not forget that history of where patient was born and travelled will be of importance when one is suspicious of Amoebic dysentery.

PHYSICAL EXAMINATION.

One should note whether patient is fat or thin, and if the latter, whether he is emaciated.

The presence of anaemia and cachexia may be also noted. The condition of the abdomen is important, whether flat or distended, whether firm, flabby or pendulous. The presence or absence of hernia should always be noted. Although the patient's bowel is our chief concern, his general condition is of importance and may have an important bearing on the diagnosis. The condition of his cardiovascular system, kidneys, liver and chest should be investigated together with a quick examination of his nervous system. The abdomen should be carefully palpated for points of superficial and deep tenderness, masses, enlargements of liver and spleen, and condition of hernial orifices. As mentioned above, a thorough examination is not complete without a careful digital examination of the rectum.

LABORATORY EXAMINATION.

It is obvious to all that blood will occur in the faeces from bleeding anywhere within the gastro-intestinal tract but its character will be changed depending on the site. It is important that the doctor himself see the stool in gross before any laboratory examination is done. When it occurs high up the blood is mixed intimately with the faeces and if sufficient in amount dark tarry stools will result. If the haemorrhage is very profuse, even a duodenal ulcer may produce frank blood in the stool. If the bleeding is low

down in the tract, frank red blood will appear, some mixed with the faeces and some on the surface. On the other hand, if haemorrhage occurs low down in the rectum from internal haemorrhoids, then the blood will be bright red and only on the surface of the stool. Frank red blood may also occur at times from carcinoma of the caecum.

Before carrying out the usual chemical tests it is wise to be sure that the patient has not been eating too freely of under-cooked meats. The usual full diet of a public ward patient produces a stool which gives negative test with Benzidine, provided there is no pathological lesion within the gastro-intestinal tract.

Testing for occult blood:

1. Piece of faeces the size of a large pea.
2. Make emulsion with water, preferably distilled.
   Shake contents well then do one of the following tests:

(1) *Spectroscopic test and Guaiacum Test.*

(a) To a convenient amount of emulsified stool add half the amount of glacial acetic acid and as much pure ether as glacial acetic acid.

(b) Shake very well—allow to stand and ether separates from water as a separate layer — decant this into a clean test tube.

(c) Divide ethereal solution into two:

1. Examine spectroscopically for oxyhaemoglobin or acid haematin.
2. Add drop of fresh tincture of guaiacum and then a few drops of 3% hydrogen peroxide.

(2) *Benzidine Test.*

(a) Emulsion of stool first boiled in a test tube and then cooled.

(b) Equal part of saturated solution of benzidine in glacial acetic acid are then added and contents well shaken.

(c) Add 3% hydrogen peroxide drop by drop.

Result—Greenish blue hue if minute quantities of blood are present. Decided purplish blue hue if occult blood is definitely present.

Read test positive if colour is present in 10 seconds. This criterion of time must be followed or test cannot be considered positive.

This last test is very reliable, sensitive and easy to perform and is really all that is necessary in practice. Fallacies for both Guaiacum and Benzidine tests are the same. That is to say, pus must be eliminated by boiling at beginning of test to destroy the oxidase enzyme which would otherwise give a positive test.

The spectroscopic test is the only specific test but it is usually not necessary to do this.

SIGMOIDOSCOPIC EXAMINATION.

The patient should be specially prepared in order that a successful and efficient sigmoidoscopic examination may be carried out. The following routine has proven very satisfactory:

(a) Low residue diet.

(b) At noon before day of examination give 1½ oz. castor oil.

(c) S.S. enema at 4 p.m. and 10 p.m.

(d) Nothing to eat or drink after midnight.

(e) Tinct. Camphor Co. drams 2 at 8 p.m., 10 p.m. and midnight.

(f) If having a Barium enema following the sigmoidoscopic examination, may have noon meal.

The proctoscope, which is usually about 6 inches long, is all that is necessary to use in examination of upper rectum. For sigmoid flexure and lower pelvic colon the long sigmoidoscope is necessary. As in the case of all special instruments, practice and experience are necessary before it can be passed with safety. It is imperative not to

administer an anaesthetic except a mild sedative, as the absence of anaesthesia necessitates more gentle manipulation and thus reduces the danger of such accidents as bowel perforation. The patient should be examined in the knee-elbow position or left Sims or jack-knife position. The latter is most preferable. It should always be made a rule that if any suspicous ulcerating lesion or polyp be noted on sigmoidoscopic examination a portion be removed at the time for pathological examination.

BARIUM ENEMA.

This is a very valuable and relatively simple way of obtaining very important information on the condition of the gastro-intestinal tract distal to the ileo-caecal junction. The following is the routine employed at the Toronto General Hospital:

1. Oz. 1½ of castor oil night before.
2. No breakfast.
3. Light lunch.
4. Plates made in the afternoon.

Proportions are 1 lb. barium sulphate to 1 qt. of water.

If a marked filling defect or alteration in the normal outline is observed, the photograph should be repeated on another occasion preferably the next day, and a good plan is to administer a dose of belladonna or atropine some little time before the second observation in order to relieve and thus rule out any spasm. If, then, the same abnormality is observed on two separate occasions, and one of these was while the patient was under the influence of belladonna, we can be fairly certain that a definite pathological lesion exists. If diverticultis is present, it can be distinguished from carcinoma by the characteristic appearance of the injected diverticula. These are best seen on a post-evacuation plate. Air insufflation immediately following the evacuation of a barium enema often gives valuable information as to the condition of the colon.

BARIUM SERIES.

This form of examination is indispensable in the final diagnosis of such conditions as gastric or duodenal ulcer, carcinoma of the gastro-intestinal tract, diverticulitis, etc., but is never done as a primary procedure and certainly is never attempted if one is suspicious of obstruction. The routine at the Toronto General Hospital is as follows:

1. Ordinary breakfast.
2. Nothing to eat or drink after.
3. Plates taken in the afternoon.
   The mixture taken is as follows:
   Water oz. 8.
   Soda Bicarb. drams ½.
   Petrolagar oz. 1 (2 tbp.)
   Barium oz. 6 (12 tbp.)

The plates if there is an abnormality present will possess the same characteristics as those taken of the lower bowel with a Barium enema.

LAPAROTOMY.

This form of examination is of course taken as the last resort, when all other methods of examination have failed to give any definite information. If amoebic dysentery is suspected, give a course of 1 cc. of emetine hydrochloride daily for a week before operation.

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The author would like to extend his appreciation and sincere thanks to Dr. Roscoe Graham and Dr. Stuart Gordon for their aid and constructive criticism in the preparation of this paper.

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BONE TUMOURS—PART III.*

EWING'S SARCOMA

By VINCENT P. COLLINS, '37.

When Ewing first included in his text on Neoplastic Diseases (2nd edition, 1922), a description of the tumour which bears his name, he modestly and briefly devoted some two pages, including illustrations, to the condition. Ewing states that it is a relatively frequent and specific disease of bone, usually unrecognized clinically and passing under the name of round cell sarcoma.

The findings of the Registry of Bone Sarcoma of the American College of Surgeons confirm the tumour as a distinct entity, although it is still not universally recognized as such. The acceptance of this view rests on a specific clinical course, a typical gross anatomy, a unique histology, and a distinctive reaction to radiation.

Origin.

Those who have studied the material of the Registry agree that this is a specific disease, but not all are willing to accept Ewing's contention that the tumour originates in perivascular or perilymphatic endothelium. According to Ewing, its origin is not from blood or vascular endothelium, but possibly from lymphatic endothelium. Codman regards it as a primitive form of osteogenic sarcoma, arising from the cells of the reticulo-endothelial system. Kolodny thinks that this is something more than a simple bone tumour, as evidenced by the differences of the involvement and the multiplicity of foci of origin in the same bone, and by the appearance of multiple tumours, frequently very early in the course of the disease. Because of the rapidity of growth, it is difficult to arrive at a conclusion as to source.

Clinical Course.

The frequency of Ewing's tumour among cases submitted to the Registry was 7.5%, or 50 cases out of 650. It predominates in males, 3 to 1. As to age incidence, it is more common from 3 to 14 years, and rare over 21 years of age. Ewing's oldest case was 19 years, but the Registry material contains 3 over 40 years.

The long bones are the favoured site, and these, in order of frequency, are tibia, fibula, humerus, ulna, femur, clavicle, small bones of feet, ribs, vertebrae and skull. The site of predelection is the shaft of the bone, but epiphyseal ends are not immune. Joint involvement is, however, unknown, for cartilage seems most resistant. Unlike osteogenic sarcoma, simultaneous development in more than one bone is almost characteristic. Multiple lesions of bone are the rule in the advanced stage, but one cannot be sure whether these are simultaneous or merely early metastases.

Trauma is frequently mentioned in the history, but as in other instances, not how often trauma precedes tumour, but how ofter does tumour follow trauma, is important.

Pain is an important and constant feature in the history. In this case, the pain is more intermittent in character than in osteogenic sarcoma. Succeeding attacks of pain increase in frequency, duration and intensity, finally becoming of a permanent nature.

There may be a considerable fever with these attacks, and the white blood count may rise to 15,000, with no significant change in the differential count.

These features may easily lead to a diagnosis of osteomyelitis and such cases have not only been operated on as such repeatedly, but the mistaken diagnosis confirmed by the pathologist.

The tumour itself may appear suddenly after several preceding attacks of pain, and is accompanied by signs of local inflammation and hyperaemia. It grows slowly at first, and may tem-

*The third of a series of six.

porarily subside and disappear between attacks of pain. With subsequent attacks, growth becomes continuous and the tumour increases rapidly in size before termination.

Metastases may be evident in weeks or years and their occurrence is frequently accompanied by febrile attacks.

Pathology.

Gross.—Ewing's sarcoma usually occupies the shaft of a long bone, involving the region from mid shaft to epiphysis, but it is rare for the latter to be invaded. The bulk of the tumour lies subperiosteally but destruction of the shaft is an uncommon finding, so that it would appear that tumour cells first infiltrate the shaft, then proliferate beneath the periosteum. The bone thus invaded responds vigorously by a laying down of subperiosteal and endosteal new bone, which is responsible for the widened cortex discernible in X-ray plates. At a later date, tumour cells may interfere with blood supply and nutrition of bone, so that destruction does occur, along with liquefaction of the tumour substance. This material has been mistaken for pus at operation.

As the tumour mass proliferates subperiosteally the periosteum is stripped up. Consequent upon this, a layer of new bone is laid down, shortly to be invaded by tumour tissue. This process repeated many times, gives rise to parallel deposits of new bone, responsible for the "onion-skin" appearance occasionally seen in X-ray pictures. In some instances, new bone may be deposited in spicules at right angles to the shaft along the path of perforating blood vessels.

The bulk of the tumour is usually covered by a thin, fibrous coat, continuous with the periosteum at the margin. The enclosed tumour is usually firm, grayish-white and divided into lobules by strands of connective tissue. Occasionally the mass shows cystic areas, due to haemorrhage or regressive changes.

Microscopic. — The histological picture is simple, with none of the pleomorphism of osteogenic sarcoma. The type cell is small and polyhedral; the nucleus is round or oval with scattered chromatin granules; the cytoplasm is clear and unstained, frequently appearing as a syncytium. Mitotic figures are abundant but there are no giant cells. The arrangement about blood vessels, described as a mantle, has given ground for the consideration of blood vessels as a unit in the structure of Ewing's sarcoma. There is a complete lack of intercellular substance, although the colourless syncytium may give an opposite impression. The tumour cells are non-productive of matrix or stroma and in this respect, may be considered more primitive than the average osteogenic sarcoma. Diffuse bone absorption is a part of the picture, but this is accomplished without the aid of osteoclasts or giant cells. The picture may be complicated by the presence of plasma cells, blood cells, bone marrow elements, or lymphocytic infiltration, so as to resemble myeloma or inflammatory lesions of bone.

Biopsy.—Biopsy of a suspected tumour, as a rule, is made in the face of the objection that such interference enhances the production of emboli. Evidence for or against this contention is difficult to produce but if the value of the measure as a diagnostic procedure outweighs the conjectured danger of metastases, then it is justified. A good pathologist is confident of his ability to diagnose the tumour even from frozen section, but it is difficult to say that a single biopsy specimen is representative.

Metastases. — Metastases occur by blood stream and lymphatic spread, and involvement of lymph glands is not uncommon. Ewing's sarcoma commonly shows secondaries in other bones, particularly skull, and in lung. These metastatic foci exhibit all the characteristics of primary tumour. These apparent secondaries in bone frequently occur so early that some observers suspect that they arise independently. However, it is uncommon for the pa-

tient to present himself for examination with more than one bone involved.

Roentgenogram.—There is a typical radiographic picture described for this tumour, but atypical films are frequent and opinion upon these is divided. One finds a diffuse involvement of the end of the diaphysis of a long bone, including a third to one-half the length of the shaft. Whereas in osteogenic sarcoma, one may characteristically follow the shaft through the tumour mass, in Ewing's, the shaft is displaced by tumour. The cortex is increased in width and shows diffuse rarefaction. Bone destruction is not usually prominent and such areas are small and multiple. New bone formation is seen in the thickening of the cortex, in the layered deposits giving the "onion skin" formation (which in experience is not frequently encountered), and occasionally in radiating spicules of bone.

Effect of Radiation.

Radiologists are in agreement that Ewing's sarcoma responds to radiation as does no other tumour. The suppression is so marked that it forms a most valuable diagnostic measure, which unfortunately is not always sought. The active objections raised against this procedure are, namely, that it is an unjustified delay; that radiation may constitute a trauma capable of being an influence in causing dissemination; and that malignancy may be increased by causing the tumour to become radio-resistant. The radiologist's answer is that radiation itself is quite as efficacious as surgery in producing a cure; that the effect of radiation is always of the nature of an insult to tumour tissue rather than a stimulation, and could not favour metastases; that there is a changing concept of radio-resistancy, whereby the changed reaction of a tumour is believed to be due, not to an effect upon the tumour cells, but to changes in vascularity and nutrition of the tumour bed, and that this can be avoided by the protracted fractionated method of radiation, carried to the point of skin tolerance, by a modification of the so-called Coutard technique.

Treatment.

The patient exhibiting a tumour of bone is one of the most trying problems confronting the surgeon. In the case of Ewing's sarcoma, particularly, the patient is frequently quite young and the sacrifice of the limb would be avoided if a prognosis at all favourable could be given with any other treatment. It has been the concensus of opinion that early, radical surgical interference is the most satisfactory method of dealing with these cases, and as yet no other form of therapy has sufficient backing to challenge this.

In the material of the Registry for Bone Sarcoma, the best results were obtained by operative surgery, followed by radiation. Kolodny suggests that the best treatment is immobilization of the affected part and radiation. If and when the tumour recurs locally, amputation or excision may be performed.

The possibilities of treatment by radiation alone have not been proven, but one feels that it has a definite place in the treatment of Ewing's sarcoma, that will be better defined only by increasing our familiarity with its use.

Prognosis.

The course of the disease is, on the whole, rather slower than osteogenic sarcoma, so that Conner is led to say that the prognosis is distinctly better and that the intelligent and persistent use of all methods of treatment at our disposal is called for. The mortality is very high, especially in younger subjects, and in young children secondary tumours occur so regularly that little seems to be gained by amputation. In older subjects, the prognosis following amputation is better. The average duration of life is about 2 or 3 years. It may be but a few months, and one case, occurring in 1909, diagnosed as Ewing's sarcoma, in retrospect, was alive and well 24 years later.

It is difficult to present a group of five-year cures that will be acceptable

to all, but Coley has published a record of 12 five-year cures in a group of 44 cases.

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OSTEOMYELITIS

By DOROTHY REDMOND, B.A., '39.

Definition.

All inflammatory affections of bony tissue might rightly be termed osteitis, but when the medullary cavity and Haversian canals, together with the periosteum are particularly affected, the term osteomyelitis is substituted. The calcified portion takes no primary active part in the process, but it suffers secondarily from loss of blood, and a greater or lesser portion of it may die.

To-day it is accepted that osteomyelitis is a local manifestation of a general blood stream infection produced by virulent pathogenic bacteria.

History.

The necessary stepping stones in the development of knowledge concerning osteomyelitis have been progressively laid down since 1820. As far back as the time of the Smith Papyrus, 5000-3000 B.C., there have been records showing a knowledge of diseases of bone which were treated along with all other inflammatory conditions by poultices of ground snakes, frogs and herbs. This fund of information assisted by the development of anatomical knowledge, gave rise to divers descriptions of bone diseases, all of which were obscurred by the mingling with them of ideas on the generation and formation of disease.

About 1780 John Hunter wrote extensively on the diseases of bones, showing that he recognized the formation of an involucrum, and of sequestrae, but he displayed a lack of differentiation between luetic and pyogenic involvement.

By the time of Cragie, 1828, most authorities admitted that the bones might be inflamed either spontaneously or as a result of injury, but there was no precision of ideas on the subject.

Nelaton's book on Surgical Pathology, published in 1844, distingished between inflammation of hard bone, or "osteitis," and inflammation of the medulla or "osteomyelitis." But with Nelaton, treatment was still in its infancy, and consisted of local applications and general measures appropriately called "antiscorbutic and antiscrofulous" and so on.

Most of the histories of the disease give the impression that after the period of the Crimean War modern knowledge began to be evolved and that it has progressively gone on to reach the present stage.

Aetiology.

(a) **General Incidence.**—The average figure obtained from reports of four

different children's hospitals is 0.4% of admissions.

(b) **Sex.**—The preponderance of the disease in the male (6:1) has been emphasized by all observers, the explanation being that boys are exposed in a higher degree than girls to the predisposing factor of trauma. It has also been suggested that the skin of boys is more subject to mild infections.

(c) **Age.**—The most common age incidence is from 8-16 years. This preference has some connection with the growth of the bones. The vessels of the bone and periosteum which later undergo a process of involution, are in this period well developed. "The distribution of the vessels, the retardation of the blood stream, especially in the capillary loops at the epiphyseal line, and the transformation of the cells play a highly disposing rôle."

Green and Shannon report that osteomyelitis is sometimes found in the age period from three months to two years, but that there are differences between the syndrome of infants and that of older children, viz.:

(1) The organism in infants is nearly always streptococcus.

(2) The anatomical construction of bones in infants is characterized by larger cancellous spaces in the bone, allowing infection to pass more readily from its site of origin, the metaphysis, to the subperiosted space. Also the periosteum is more loosely attached in infants' bones and thence allows the decompression to occur. The periosteum then ruptures, allowing pus to escape into the soft tissues.

(3) The absorption of dead bone occurs most rapidly in infants, as does also formation of new bone.

(d) **Localization of Foci.**—The order of frequency of occurrence is as follows:

1. Long bones, 94%.
2. Lower extremity, 77.4%.
3. Upper extremity, 19%.
4. Flat bones, 1.8%.

The long bones are affected in the following order:

1. Tibia.
2. Femur.
3. Humerus.
4. Fibula.
5. Radius.
6. Ulna.

Anatomical Factor.

Architecture of a Long Bone.—A typical long bone is a tubular structure, the interior of which contains the medullary cavity, which is lined by the vascular internal endosteum and houses the marrow. At each end, this gradually merges into a larger mass of loose cancellous tissue, the interstices of which are similarly packed with vascular medulla, which performs the functions of maintaining the nutrition of the bone and of elaborating the blood. "Surrounding all of this is a layer of cancellous bone tissue, which is gathered and disposed about the medullary cavity, according to the physiological needs of the given bone in order most efficiently to respond to the stresses and desires which the bone must undergo in the ordinary life of the organism." (Wolff's Law). Usually the cancellous tissue is thinnest at the centre of the bone. Outside of all this, covering the cancellous layer is a variable thickness of compact bone. The articular surface of the bone is covered with hyaline cartilage. The entire bone, with the exception of this joint surface, is enveloped by the periosteum, a specialized dense connective tissue layer. The connection between the bone and periosteum is such that they can be separated only with great difficulty at the epiphyses of long bones, and at the places of attachment of tendons and muscles. In young bones, the periosteum is thick and very vascular, and it is separated from the bone by a layer of soft osteogenic tissue containing a number of osteoblasts by which ossification proceeds on the exterior of the young bone.

Blood Supply in a Long Bone.

(1) The medullary cavity is supplied from the nutrient arterial system. The nutrient artery sends branches up-

ward and downward to ramify in the medullary membrane, and to give twigs to the adjoining Haversian canals.

(2) The cancellous and cortical layers of the diaphysis of the bone are supplied by the anastomotic plexus between the nutrient artery and the periosteal system.

(3) The epiphyses are supplied by a number of perforating vessels from various sources, constituting an irregular system. In young people, the epiphyseal cartilages segregate this circulatory system from the others mentioned above. After complete ossification of the bones, this segregation disappears and vascular communication is set up with the nutrient artery and the periosteal plexus.

Experimental Results.

In experimental work, it has been recognized and established that the ordinary form of osteomyelitis is a blood-borne infection. Dr. D. E. Robertson, of the Hospital for Sick Children, Toronto, Ont., sums up his own as well as other experimental findings as follows:

(1) Organisms introduced into the blood stream are deposited, among other places, in the long bones.

(2) In bone, there is very active phagocytosis, except in the metaphyses of long bones.

(3) Organisms produce inflammatory centres in the metaphyses, independent of trauma.

(4) It is impossible to produce a general infection of the medulla by a simple innoculation of organisms into the blood stream.

(5) Trauma may determine a local infection.

(6) Growing bones develop abscesses of the type of osteomyelitis within them. Adult bones do this but rarely. In the presence of a bacteremia, adults may develop an arthritis.

Bacteriology.

The staphylococcus aureus is most commonly found associated with acute osteomyelitis. The relative occurrences of the different organisms are given by Rose and Carless as:

(1) Staphylococcus aureus, 78%.
(2) Pneumococcus, 14%.
(3) Streptococcus, 6%.

Other organisms mentioned by authorities as possible infecting agents are the paratyphoid bacillus, bacillus coli, bacillus typhus and bacillus aerogenes capsulatus. Mixed infections with more than one organism are also found.

Pathogenesis.

According to Delafield and Prudden, acute infectious osteomyelitis occurs in the following ways:

(1) As the result of a local injury which permits the access or favors the development of pyogenic micro-organisms.

(2) It may be metastatic, resulting from the transportation of infectious material from other parts of the body in septicemia and pyaemia, in typhoid fever in the exanthematous fevers, and under other conditions.

(3) In may occur without evidence of local predisposition or of infectious processes in other parts of the body.

It would appear from the experimental work that trauma is not an essential factor in the production of osteomylitis. However, Dr. Robertson brings out that, clinically trauma has some relation to the initial bone lesion. A very slight injury, which is often overlooked, will suffice to cause by autoinfection a rapidly spreading inflammatory process. The ligaments and tendons that are concerned with the stabilization of the joints are attached into the epiphyses, and hence articular strain must be felt mainly in the region immediately beyond their insertions, and it is common in children to have the epiphysis detach from the diaphysis. If the strain is not sufficient to cause a complete separation, an injury may occur at the cartilage line with haemorrhage, injury of cell and consequent

lowering of resistance. If the child has foci of infection in any other part of the body, such as boils, diseased teeth, ulcerated gums or sore throat, which predispose to bacteremia, localization will take place at the injured point. The nature and extent of the inflammatory phenomena depend largely on the exact situation of the infective focus, the amount of resistance offered by the surrounding tissue and the virulence of the organism.

Pathology.

Acute osteomyelitis nearly always starts in the soft vascular tissue of the metaphysis, but in a few instances it may be preceded by a patch of localized periostitis, suggesting that an acute infection has supervened upon a subacute peri osteal focus. The metaphysis possesses a rich blood supply, and branches of the nutrient artery end in sharp hair-pin bends, in which clumps of bacteria are readily arrested. As in other parts of the body, the organisms travel along the line of least resistance:

1. If the process commences in the periphery of the juxta-epiphyseal region close to the periosteum, the line of least resistance will be towards that structure, and hence the initial lesion will be a focal suppuration (sub-periosteal abscess), while the central portions of the bone may escape almost entirely. The pus lifts the periosteum from the bone and at the same time makes its way along the outside of the shaft. Owing to the inflammatory condition, there is a great increase in tension within the rigid walls of the cancellous spaces and the Haversian canals, so that the blood vessels are compressed and their lumina obliterated. Many become thrombosed and septic thrombi form a great menace, namely, the formation of pyaemic abscesses throughout the body. These factors cut off the blood supply from the calcified parts, and consequently considerable portions of the diaphysis may become denuded. This in turn may result in extensive necrosis. When a portion of bone has died, inflammation occurs at the dividing line between the dead and the living bone, and finally it separates off the dead bone as a sequestrum. Although the periosteum is separated from the bone, some of the cells of the osteogenic layer usually survive and are stimulated by the inflammatory process. Therefore, when the acuteness of the infection is past these osteoblasts, lay down new bone over the sequestrum in the form of a new case or involucrum. This is lined by granulation tissue, and is perforated by cloacae, through which passes pus produced by the irritation of the dead bone. But the ossifying periosteum, being separated from the dead bone by a film of pus, never becomes adherent to it, though it speedily attaches itself to the healthy shaft, with which the new bone becomes incorporated. So it comes about that the sequestrum is imprisoned in a bony cavity, from which it cannot escape. The involucrum is at first porous and light, but it gradually becomes more dense, and eventually it is sclerosed and heavy.

2. Should the process start in the centre of the metaphysis, it may spread in several directions, and the results of this spreading may vary considerably.

(a) If the infection spreads along the medullary cavity, hyperaemia and oedema of the medulla result and a diffuse suppuration and gangrene may occur. The periosteum becomes oedematous and infiltrated with pus, and the membrane is stripped up from the diaphysis. Unless prompt measures are taken to limit the progress of the disease, necrosis is certain to follow, usually involving the whole thickness of the diaphysis, and sometimes its whole length.

(b) Owing to the intimate connection between the periosteum of the diaphysis and of the epiphyseal cartilage, the neighboring joint usually escapes infection. But sometimes the junction cartilage is softened or destroyed by the organisms, so that the inflammation may spread through the epiphysis to the articular cartilage,

which is eroded, and the joint is opened.

(c) When the organisms are of a less virulent type, the process may be much more localized and subacute in nature, resulting in a limited central necrosis or in a chronic Brodie's abscess inside the bone.

(d) The process may go out from the central metaphyseal focus to reach the periosteum and then the phenomenon of a diffuse subperiosteal abscess will ensue, giving the picture explained at the first of this discussion.

Signs, Symptoms, and Diagnosis.

The history of the patient must be thoroughly investigated. In nearly all instances there is a definite history of injury to a joint or to its region, often resulting in impaired function. After a short period, there is recovery of function, and the patient is well until local symptoms occur at the site of the trauma.

It is a clinical fact that bone infection does not manifest itself at the same time that any skin infection is at its height. Therefore, the history should be invesigated for any abrasion of the skin occurring with the trauma, or for a furuncle present at that time. In the absence of a skin lesion, search should be made for lesions in the nose, mouth or throat. Finding the original primary focus makes it possible to classify the lesion, and frequently helps to establish a diagnosis.

Acute osteomyelitis usually begins with the customary symptoms of any acute infection — a chill, high fever, rapid pulse, nausea and restlessness. Sometimes the onset is preceded by headache, malaise and pain in the limbs. The patient complains of stiffness in the vicinity of a joint, and there is definite tenderness in the region as time goes on. As a result, a rigidity is imposed on the part and function is abandoned. The pain shows no remissions in the first few days. After 24 hours, the symptoms are all increased and the contour of the part which was previously normal shows local swelling and redness, which progress towards the shaft of the bone away from the joint. In other cases, the focus, from its very beginning, seems to involve the entire shaft immediately, as the visible swelling seems to begin at the centre and to spread towards either end of the bone.

Anaemia of a varying grade is a regular accompaniment of an acute osteomyelitis. It is produced by the blood destruction resulting from the presence of a bacteremia, or it follows the debilitating effects of the progressing suppuration. The while cell count may be increased to 12,000, and sometimes it reaches a level of 25,000. The lymphocyte count may be decreased as low as 5%, but there are many exceptions to this rule.

In the diagnosis of the disease, roentgenology gives little help during the first week, because there is no rarefaction of bone. After seven days, a change in the bone is evident. This consists in a linear separation of the periosteum from the underlying cortex over the entire extent of the site of the infection. At this time, the bone texture appears normal. In the bone tissue itself, the X-ray will not show anything of a definite nature until there is rarefaction of the bone, and from ten to fourteen days are required for the absorption of a sufficient quantity of lime salts, so that an area of increased radiability will be demonstrable on the plate. Plates taken at successive periods during the first two or three weeks of the illness will show an apparent advancement of the lesion, when in reality the lesion itself has been present from the beginning, but its radiological characteristics have been changing progressively.

Treatment.

The treatment of the disease is surgical and entails the early drainage of the lesion. As soon as the diagnosis is made, when the pain is in the metaphysis only, and as yet there is no swelling to disturb the contour of the

limb, a free incision should be made in the long axis of the limb through the periosteum. The incision must be planned to be at the most dependent point, as the patient lies in bed. It is possible in these early cases to scrape away the softened and hyperaemic bone, together with any necrotic tissue which may be present. The cavity thus formed is drained or packed with gauze.

If the case is not seen until a later stage, the periosteum may be found to be stripped from the bone for a varying distance. In such a case, it is essential to pass drills into the metaphysis parallel to and close to, the epiphyseal plate, as suggested by Starr. One of these holes may tap the inflammatory centre and may allow pus to escape. It is then essential to remove a small window from the cortex of the bone, and leaving the wound well open, establish free drainage in this way.

Drainage from a wider area must be established if there is much swelling in the soft tissues, as shown in cases where the disease has existed for several days. Probably, by this time, part of the medulla will have been invaded, and it must be drained freely and disinfected well.

After the acute symptoms have subsided, and there is no further advance of the disease in the bone, drainage and strict asepis are maintained until the sequestrum has had time to become separated from the living bone. This usually takes two to three months. Sequestrotomy is then performed. The cavity is then cauterized, irrigated and packed with gauze.

Prognosis.

The prognosis of the acute form of osteomyelitis is always grave. Life may be threatened by pyaemia or toxaemia in the early stages, while later amyloid disease and exhaustion may terminate the case if a mixed infection has occurred. The efficiency of the limb may be unimpaired if the disease has not been too extensive, and if prompt treatment has been adopted. However, if there is a toxaemia or if the neighboring joints suppurate or if the osteogenic powers of the periosteum have been destroyed by the acuteness of the process, amputation may be required.

Summary.

1. The condition of acute osteomyelitis shows an incidence of 0.4% in chilren's hospitals.

2. The bone lesion is in the metaphysis of the bone of a growing child.

3. The primary bone lesion is determined by trauma.

4. The most common bacteria found in association with the disease is the staphylococcus aureus.

5. An accurate clinical history is of great importance in the diagnosis of this condition.

6. The chief symptom is pain. The chief sign is tenderness over the involved metaphysis.

7. The treatment is early operation into the metaphysis for the purpose of drainage.

8. As far as life is concerned, the prognosis is not unfavorable as long as manifestations remain localized. The prognosis becomes very serious when evidences of a general sepsis preponderate.

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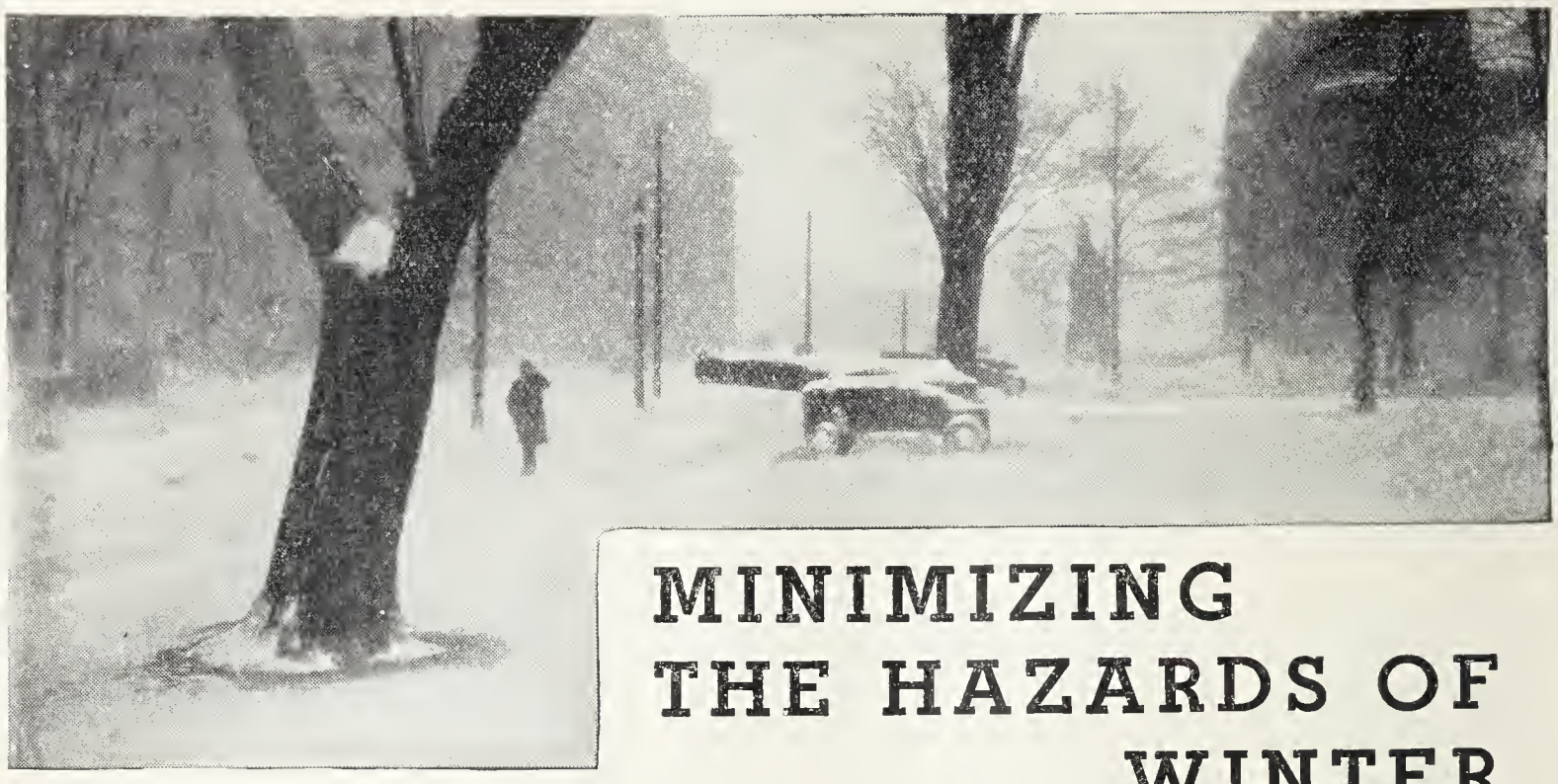

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HUMORAL TRANSMISSION OF NERVE IMPULSES.

By R. L. McDONALD AND R. C. SMITH, '40.

History.

The first intimation of the possibility of the chemical mediation of nerve impulses is to be found in a paper published by T. R. Elliott of Cambridge in 1904. He observed that the structures innervated by sympathetic nerves responded in a characteristic manner to adrenaline injection, long after these nerves had been cut and had degenerated, contracting or relaxing where sympathetic impulses had previously caused contraction or relaxation respectively. It was suggested that the arrival of the sympathetic impulse at a smooth muscle cell, for example, might cause the local liberation of adrenaline which acted as a chemical mediator in the process of stimulation. In 1905 Langley, also of Cambridge, explained the two types of reaction shown by different responsive cells by assuming that two types of substance existed within the cells, excitatory and inhibitory. When adrenaline reached the cell its action there was determined by the type of receptive substance present.

Dixon and Hamill in 1909 noted the nerve stimulation and the effects of certain drugs. Muscarine injection and vagal stimulation were assumed to act in a similar manner in inhibiting the heart. Thus, it was argued, excitation of a nerve induced the liberation of a hormone which combined with some constituent of the end organ to cause some specific activity. Muscarine was here suggested as the mediator of vagal impulses, whereas Elliott suggested adrenaline as the intermediary in the case of sympathetic impulses.

Potassium salts were known to have an effect on the heart very similar to the inhibition caused by vagal stimulation, and it was suggested that vagal stimulation might exert its inhibitory influence through the agency of potassium compounds. Hewell reported that vagal stimulation caused an increase in the potassium content of Locke's solution perfused through an isolated heart. Although this clearly expresses the concept of chemical transmission, neither this theory nor the data supporting it have fitted into the progressive developments leading to our present understanding.

In 1906 Hunt and Taveau isolated an unstable choline ester, acetylcholine, from an aqueous extract of the suprarenal gland. It had a marked blood pressure reducing effect, being a hundred thousand times more active than choline. Dale, 1914, observed that the pharmacologic changes produced by the injection of this ester were identical with those produced by stimulation of the parasympathetic nerves. The effects were very brief and were abolished by atropine.

Loewi found that the muscarine-like substance liberated in the heart by vagal stimulation diffused out into a salt solution in contact with the inhibited heart. The presence of this substance was proved by perfusing the altered solution through a second denervated heart, which was inhibited. A cardio-accelerator substance was shown to be liberated by stimulation of the sympathetic nerves to the heart. This phenomenon was found later to be true for other parts of the body.

Cannon and Uridil reported that stimulation of the splanchnic nerves caused an increased rate in the denervated heart, but after removal of the suprarenals this stimulus had a less marked effect.

Such contributions as these led separately to the proof of a humoral factor in the mediation of nerve impulses in both sympathetic and parasympathetic systems.

Sympathin.

Cannon devised a method of separating the heart surgically from the central nervous system, leaving the animal in an otherwise normal state. In this condition though not subject to nervous control, the heart was found to be strikingly influenced by changes in the circulating blood, especially to minute changes in adrenaline concentration (1:14,000,000). Such stimuli as emotion, asphyxia, pain, or exercise caused an immediate rise in heart rate. After adrenalectomy this rapid acceleration no longer appeared, but a delayed, slow, limited increase in the rate was noted. By surgical means Cannon proved that this increased rate ceased only after the total removal of the sympathetic system. Stimulation of the isolated lower thoracic sympathetic ganglia, which innervated only smooth muscles of the vessels and hairs in the tail region, resulted in a pressor effect. The only functional connection between the denervated heart and the denervated tail was the vascular system, and when the blood flow in to and out from the tail was blocked, the same stimulus had no effect on the heart until the block was removed. Further, Cannon and Bacq showed that by stimulation of sympathetic nerves to any smooth muscle a similar sympathetic effect was produced on the heart and other denervated structures. Thus it may be concluded that excitation caused the affected cells to liberate a substance into the blood stream and this substance, carried elsewhere in the body, produced effects similar to sympathetic impulses. This phenomenon occurs under quite normal conditions, no drug being necessary to make it obvious.

Cannon and Bacq called this sympathomimetic substance "sympathin" in place of the cumbersome term "sympathetic substance."

In many respects sympathin and adrenaline are identical. Both have pressor actions, increase the secretion of saliva, increase blood sugar, contract the cat's nictitating membrane, inhibit the intestine, dilate the pupil and have other sympathetic effects. Chemical studies also suggest that the two are closely related. Both are catechol derivatives with an animated side chain in the para position. However, there is nothing to prove sympathin identical with adrenaline, nor to exclude its being a mixture of more than one such compound. A modified Viale test, which is specific for any substance with a chemical structure similar to that of adrenaline, showed that after stimulation of the sympathetic nerves to the eye, the aqueous humor contained more adrenaline-like substance than before stimulation. Thus, until 1933, it was assumed that sympathin was adrenaline produced locally in a responsive cell on the arrival of sympathetic impulses.

However, Cannon and Rosenblueth showed that if ergotoxine were injected before adrenaline, the usual pressor effect of the latter was abolished and was replaced by a depressor action. Ergotoxine had no such effect on the increased blood pressure and heart rate after sympathin. Therefore adrenaline and sympathin cannot be identical.

Sympathetic stimulation was known to produce relaxation or inhibition in some structures and contraction or excitation in others. Adrenaline and sympathin also show this phenomenon. Sympathetic stimulation was found to produce two kinds of sympathin:

(a) sympathin E, which, in very minute amounts, contracts the cat's denervated nictitating membrane.

(b) sympathin I, which relaxes or inhibits the cat's non-pregnant uterus. However, adrenaline is a simple chemical substance which produces both excitatory and inhibitory effects on denervated organs. Thus the factor determining the type of reaction must exist within the responsive cell. Rosenblueth postulates the formation of a substance (M) at the endings of stimulated sympathetic nerves, which combines with a substance (H) within the cell, the resulting response varying with the amount of MH formed. If a mixed response results from stimulation, it is ne-

cessary to divide the receptive substance (H) into an E factor which determines excitation, and an I factor which determines inhibition. The substances which enter the blood steam or perfusate are then ME and MI, which are sympathin E and sympathin I respectively.

Acetylcholine.

Loewi's experiment was the first proof of the chemical transmission of parasympathetic impulses. It was concluded that the nerve impulses in the vagus caused the liberation of a substance at its endings, and that this substance was responsible for the inhibition. Loewi showed that atropine blocked the effect of this substance on heart muscle but not its formation at the nerve endings. The inhibitory substance was named "vagusstoff." It proved to be very unstable, its potency soon being lost in perfusion fluids or extracts.

The first problem was to discover the chemical nature of this vagus substance. The only known substance having the required physiological potency was acteylcholine, the properties of which had previously been investigated by Dale. Detailed comparison of Loewi's vagus substance with acetylcholine, both with respect to their physiological and chemical reactions, failed to show any quantitative or qualitative difference. The identity of the two is now generally accepted, although it has never been possible to identify acetylcholine in perfusates where it is present in almost infinite dilutions.

Further research showed that the instability of acetylcholine in tissues or tissue-contaminated perfusates was due to the presence of an enzyme, cholinesterase. This enzyme inactivates acetylcholine, presumably by hydrolysing it into relatively inert choline and an acetic acid derivative. Eserine in very minute concentrations inactivates this enzyme and thus preserves acetylcholine.

Loewi's work on frog hearts led to the discovery of the same mechanism in mammalian hearts by Feldberg and Krayer. It seemed extremely unlikely that the acetylcholine mechanism would be limited to the parasympathetic innervation of the heart. The fact that acetylcholine is destroyed by cholinesterase immediately after its release makes it a suitable mechanism for specific local stimulation, since it does not accumulate in the blood and tissues. It was suggested that all parasympathetic terminations might transmit by acetylcholine.

The work on the heart indicated that three criteria could be used for identifying an acetylcholine mechanism in other parts of the body:

(a) Potentiation of nerve stimulation by eserine and blockage by atropine.
(b) Duplication of nerve stimulation by acetylcholine injection or application.
(c) Demonstration of acetylcholine in the eserinized venous blood or perfusate.

It was found that an eserinized leech muscle went into contracture when exposed to acetylcholine and that this contracture was specific for this substance. The test was adapted to quantitative as well as qualitative determination of acetylcholine.

By this method, most of the accessible parasympathetic postganglionic terminations have been shown to transmit by acetylcholine.

There is equally good evidence that some sympathetic postganglionic fibres transmit by acetylcholine. Dale has shown that the sympathetic innervation of the sweat glands and certain of the sympathetic vasodilators, notably of the limbs, are in this class. In view of this duplication, Dale has proposed a new nomenclature for the autonomic system. Fibres which transmit by acetylcholine, he proposes to call cholinergic, those which transmit by sympathin, he calls adrenergic.

In the intact, eserinized animal, atropinized to eliminate peripheral effects, a relatively large dose of acetylcholine (5 mg.) caused a rise in blood

pressure, an increase in the heart rate and vaso constriction. This pressor response was not affected by the usual doses of atropine, but was abolished by large doses of nicotine, an autonomicganglion-cell poison. This suggested that preganglionic autonomic fibres might be cholinergic. Feldberg investigated this and found the suggestion to be a fact. The innervation of the adrenal medulla, which is embryologically homologous with the ganglion cells and supplied by splanchnic preganglionic fibres, was shown to be cholinergic. It is worth noting that adrenergic innervation would be disastrous here, as adrenaline secretion would be its own stimulus, and thus, once started, would never stop.

Numerous facts indicate that motor nerves to voluntary muscles might be cholinergic. After removal of the ciliary ganglion, motor fibres sometimes grow down the paths of the degenerated constrictor fibres to the iris and establish functional connections there. It has been found that only cholinergic fibres will replace cholinergic fibres. Also, after section and degeneration of its motor nerves, voluntary muscle goes into contracture on prolonged stimulation of the cholinergic autonomic supply to that region. This effect was noted in the tongue (Vulpian effect), in the cheek (Rogowicz effect) and in the leg (Sherrington effect) and is attributable to the formation of acetylcholine faster than it can be inactivated. It has also been found that isolated denervated muscle in Locke's solution goes into contracture when acetylcholine is added. In the disease myasthenia gravis, there is a local weakness, or even flaccid paralysis of a muscle or group of muscles, without demonstrable lesions in either muscle or nerve. This condition is very similar to crurare poisoning. Administration of eserine or its analogue prostigmin causes marked temporary improvement.

Dale and Feldberg have shown that acetylcholine appears in muscle when its motor nerves are stimulated. It would seem that intra-arterial injections of acetylcholine should cause a twitch. Actually, the results obtained were elicited only when large doses were given and were irregular. Recently, however, these workers have shown that if injections are made into empty arteries and then are washed through with perfusing fluid, so as to produce a high transitory concentration at the nerve endings, a twitch results.

Acetlycholine itself has an activity other than stimulating. When present in concentration only a little above threshold, it depresses the response of both ganglion cells and muscle fibres to nerve stimulation. This depressive action is reversible.

Eserine potentiates or sensitizes the effectors to nerve or acetylcholine stimulation, by protecting acetylcholine from hydrolysis. The precise mechanism is debatable. The possibilities are:

(a) That acetylcholine, persisting at the nerve endings, continues to stimulate the effectors as they emerge from their refractory period.

(b) That acetylcholine, thus protected, diffuses to quiescent effector cells and stimulates them. The repetitive effect has been demonstrated in muscle by Dale, but has not been observed in ganglion cells. In large doses, eserine has a secondary paralytic action on ganglion cells.

The action of atropine is to block the receptor system at the nerve endings. Its action is not uniform, however. It does not completely abolish the transmission of vagal impulses to the intestine. Ganglion cells are blocked only by high concentrations of atropine, and muscle spindles are apparently unaffected.

Conclusions.

1. The presence of a chemical factor in the transmission of nerve impulses is proved by numerous conclusive experiments.

2. Stimulation of sympathetic postganglionic fibres releases an adrenaline-

like substance at the nerve endings, which is called sympathin.

3. This substance can be carried to all parts of the body by the blood and exert typical sympathetic influences.

4. Two types of sympathin are produced: E by structures which respond by excitation to sympathetic stimulation., and I by structures which are inhibited.

5. Sympathin and adrenaline are not identical, since the ergot alkaloids abolish the pressor effect of adrenaline, but not of sympathin E.

6. Stimulation of the parasympathetic fibres causes the formation of acetylcholine, which is inactivated by cholinesterase in the blood and tissues.

7. All preganglionic fibres and some postganglionic sympathetic fibres are cholinergic. There is evidence that motor nerves transmit by acetylcholine.

8. Eserine prevents the inactivation of acetylcholine by cholinesterase. This drug is of value in the treatment of myasthenia gravis.

9. It is suggested that one way conduction is a necessary corollary of humoral transmission, and that fatigue of nerve endings may be interpreted as exhaustion of the transmitter.

10. Sympathin is much more stable than acetylcholine. Its influence is widespread and it may be carried in the circulating blood without being inactivated as acetylcholine is. This is to be expected since the sympathetic system is organized to produce widespread related adjustments of bodily processes. On the other hand, the parasympathetic neurones are arranged for specific effects on certain organs.

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ARTIFICIAL RESPIRATION

By W. BUTT, '40.

Every year the number of fatalities resulting from drowning, electric shock and gas poisoning reaches a surprising limit. In the United States, it has been estimated from figures compiled by insurance companies, that over 12,000 people die annually from such causes. There is little doubt that many of them might have been revived if proper methods of resuscitation had been applied.

It is the purpose of this paper to bring together the various important manual methods and mechanical devices used in performing artificial respiration, especially in the field. The principles of each will be discussed, and the more important methods will be dealt with in detail.

Application.

Artificial respiration is applied in all cases where normal breathing has ceased. Some of the more important cases are drowning, electric shock, asphyxia from poisonous gases, obstruction of air passages, and obstruction of respiratory movements owing to excessive weight on the chest.

In drowning cases, surprisingly little water is found in the lungs. The air in these organs prevents the water reaching any further than the main air passages. This water is readily removed by lifting the patient up under the abdomen and giving him a few smart shakes. The lack of oxygen entering the lungs while the victim is submerged in the water allows an excess of carbon dioxide to accumulate in his blood, and this state of affairs soon renders him unconscious.

Electric shock cannot be classed as a true asphyxiation. If the electric shock is weak, the person is rendered unconscious, but the breathing is not stopped; if the shock is strong, however, the person is not only rendered unconscious, but his breathing ceases as well, due to inhibition of the respiratory centre in the medulla. Exposure to strong electric currents causes instant death from fibrillation of the ventricles of the heart. In all cases of electric shock, if the slightest hope of a spark of life remains, artificial respiration should be instantly applied and continued perseveringly for at least four hours. Cases have been revived after nine hours of uninterrupted application of the Schafer method of artificial respiration.

In an atmosphere excessively high in carbon dioxide, gaseous exchange in the lungs is interfered with. The cells of the respiratory centre of the brain are the first to be seriously affected by this condition of carbon dioxide excess and oxygen lack. The action of the centre is first stimulated but is soon inhibited and breathing ceases.

Smoke has its destructive effect on respiration in two important ways: (1) The smoky air is rich in carbon monoxide and low in oxygen content. Exposure to such a medium for even a short time is fatal. (2) The smoke contains many minute particles, which are exceedingly irritating to the mucous membranes of the air passages, and stimulate excessive coughing which soon becomes so violent that air is unable to reach the terminal alveoli of the lungs to produce aeration. This latter effect, coupled with the low oxygen content of a smoky atmosphere, soon brings about asphyxiation of the victim.

Petroleum vapours bring about asphyxiation in very peculiar ways. Inhalation of these vapours cause headache, dizziness, intoxication, anaesthesia, and finally death. In some special cases, the vapours are actually absorbed by the blood, and asphyxiation is due to resulting nervous disorders.

The other important poisonous gases encountered in industry are hydrogen

sulphide, and the oxides of nitrogen. Ammonia and sulphur dioxide fumes have serious irritating effects on the mucous membrane, and cause violent coughing which prevents aeration of the vital sections of the lungs. Such gases as chlorine, bromine, acid and miscellaneous chemical vapours, phosgene gas, hydrochloric acid gas and carbon tetrachloride vapours, have an irritating as well as a corrosive action on the walls of the air passages, and greatly reduce the essential aerating areas of the lungs.

The lodging of large pieces of food, false teeth, and the like in the air passages, as well as excessive swelling of the tissues of the throat as in the case of corrosive poisoning, readily bring about asphyxia. Workers in trenches and tunnels are frequently trapped by large weights falling upon their chests, hindering their respiratory movements. The respiratory centre is soon seriously affected and breathing stopped.

Historical Sketch.

The history of the methods of artificial respiration shows a very interesting development.

In the Old Testament (I Kings, XVII, 17) it is recorded that Elijah restored the breath in a boy.

One of the earliest manual methods of which we have record is the Flogellation Method. The victim was laid on his back, and the abdomen was struck repeatedly with a long flail. Around 1773, the popular means of resuscitation from drowning was to place the unfortunate one over a barrel, and to roll him back and forth by grasping him around the ankles. At the beginning of the nineteenth century, the Trotting Horse Method was in vogue. The apparently drowned was thrown over the back of a horse, which was then made to trot. The rhythmical jarring was supposed to bring about the desired effect. A few years later this odd method was replaced by the Dalrymple Method. The patient was rocked rhythmically from side to side by a long belt, which passed around his chest; the ends of the belt were grasped by two operators who stood on opposite sides of the body. The use of the Flexion technique was adopted towards the middle of the century; the body was alternately flexed and extended with attempts to imitate expiration and inspiration.

Towards the close of the last century great advances were made in resuscitation technique. The Sylvester Method showed marked improvement over any previous one used. The Marshall Hall and the Howard Methods were also developed. The Royal Medico-Chirurgical Society in 1897 appointed a committee with Professor Schafer at its head to determine the efficiency of the various methods then in use. It was found that all these methods had the disadvantage that the patient was laid on his back. This position makes difficult the escape of mucus and water from the air passages in the case of drowning, and also permits the tongue to fall back and block the throat. Pressure on the lower part of the chest is likely to cause rupture of the liver which, in cases of asphyxia, is greatly congested. A "prone-pressure" method called the Schafer Method was recommended to replace the former ones.

The latest manuel method to be introduced is the Holger Nielsen Method, devised by a Danish sports inspector. Like the Schafer Method, the patient here is also in the prone position.

Such mechanical positive pressure devices as the lungmotor and the pulmotor were introduced, and widely advertised throughout the country. On account of the many deaths that resulted from their use, however, they were soon condemned.

Many of the recent advances in artificial respiration are to be attributed to the valuable researches carried out by Drs. Yandell Henderson and Howard W. Haggard of Yale University. They recommended the administration of mixtures of oxygen and carbon dioxide in proper proportions. The H-H Inhalator was consequently developed, and

has proved of great value in resuscitation work.

Schafer Method.

The Schafer Method is the one which is in the greatest use at the present time. Regardless of the cause of the asphyxia, the essential technique is followed in every case. As soon as the patient is brought to safety, prepare him immediately for artificial respiration.

(1) Clear air passages by quickly placing the finger in the mouth and throat of patient to remove foreign bodies, such as food, false teeth, tobacco and gum. If unable to open mouth, pay no attention to it until later,—immediately begin artificial respiration. Do not stop to loosen clothes; every moment of delay is serious.

(2)Lay patient face downwards with both arms extended above the head. (Prone position). Protect his nose and mouth from dust or sand by turning his head to one side, and rest it on his forearm. No pad is placed under the patient, as this is liable to cause rupture of the congested liver.

(3) Kneel, straddling patient's hips, or if this is impracticable, place the knees on either side of one thigh, thus holding the patient firmly between the knees. Place hands over lower ribs; fingers are held slightly open and pointed towards shoulders, with tips at lower angles of the scapulae; the thumbs are placed nearly parallel and close to the spine.

(4) Arms must be kept straight and rigid while your body is swung slowly forwards, so that weight is gradually brought to bear straight downwards upon the lower part of the patient's chest. This forces the viscera of the abdomen upwards against the diaphragm, pushing air out of the lungs as in expiration. The above movement is done to the counts 1-2. Violent pressure must be avoided in fear of damaging internal organs.

(5) On the count 3 quickly relax pressure on the chest, but do not remove hands. Swing back on counts 4-5, and rest on your heels. The elasticity of the ribs allows the chest to expand to its former size. The viscera descend into the abdomen, allowing the diaphragm to descend and air to be drawn into the lungs. Inspiration is thus simulated.

(6) These movements are repeated 12-15 times per minute by a rhythmical swaying forwards and backwards of the body from the knee joints. The body should be relaxed, and energy reserved, in case artificial respiration must be kept up for several hours. Movements may be timed in accordance with your own deep breathing. The greatest danger is in making movements too rapid. Aim at 14 movements per minute, and a good rate will be attained.

(7) Assistants may loosen tight clothing from the patient's neck, chest and waist. Blankets and hot water bottles should be placed around the patient, but on no account must any of these extra measures impede the operator's movements.

(8) The rhythm must be maintained throughout. While one operator is in action, assistants called "reliefs" should be resting, ready to relieve him. To change operators, the following procedure is a good one to follow: The relief kneels on the right side of the patient, opposite the hips, and places his right hand over the same hand of the operator, and his left hand on the operator's right shoulder. In this position, he picks up the rhythm by going down 1-2, back 3-4-5, down again 1-2, then on the count 3, the operator lifts his right knee and swings over to the left of the patient, leaving his hands in position. The relief places his left knee over to the patient's left side, and brings his left hand into position over that of the operator on the counts 4-5. Both go down on counts 1-2 again, and on count 3, the operator disengages, leaving the relief to carry on with the rhythm unbroken.

(9) Artificial respiration should be continued for at least four hours without interruption, if natural breathing

has not been restored in the meantime. Upon the return of natural breathing, carefully watch the patient to see that respirations do not again fail. If breathing stops, immediately begin the Schafer Method again. Promote circulation by rubbing the limbs energetically towards body. In doing this, the hands should be cupped and applied to the medial side of the limbs. No liquid whatever must be given by the mouth until the patient is fully conscious. Upon return to consciousness, a teaspoonful of aromatic spirits of ammonia in a glass of water may be given slowly. Hot tea, hot coffee, or water is also stimulating. Avoid all types of alcoholic stimulants in such cases. Always test the ability to swallow by inserting a teaspoonful of fluid between the cheek and the gums.

(10) During the resuscitation the crowd must be kept well back. The presence of a noisy, tightly packed crowd has serious effects on the newly-revived patient. On no account must the patient be allowed to resume the upright position until several hours after he has been revived. He should be kept in the recumbent position, warmly wrapped, and in a quiet place to permit of a thorough rest.

Sylvester Method.

In contrast to the Schafer Method, the patient in the Sylvester Method is placed on his back. Since, with the body in this position, the tongue would fall back into the throat and block the trachea, it must be held out. It should be grasped in a dry cloth or with a pair of pincers. If two aperators are available, one should hold the tongue, while the other performs the active movements. If you are working alone, however, hold the tongue out by a bandage or rubber band over the tongue and under the jaw. A rolled-up coat is placed under the shoulders to help straighten out the trachea.

The operator kneels immediately above the victim's head, and grasps both of the arms at the wrists. The first movement consists of drawing the arms outward and upward gently and steadily, and holding them as far as they will go above the head. This operation, which requires about two seconds, expands the chest to the greatest possible extent. The pectoral muscles are here used to help raise the thorax. The enlargement of the chest causes air to rush into the lungs.

The arms are then brought down until the elbows press against the chest, arms crossed. With a little pressure on the arms, the elastic chest cage is reduced as much as possible. By this means air is expelled from the lungs. This second movement also requires about two seconds. The above two movements are continued rhythmically for about 15 times per minute.

The Sylvester Method was often used in conjunction with the Schaefer Method in cases where signs of congestion appeared in the face. The Sylvester Method was continued for ten minutes, during which time the congestion disappeared, then the operator reverted to the Schafer Method until congestion again appeared, upon which the Sylvester Method was again applied for another ten minutes.

Laborde's Method.

Laborde's Method is used, when for any cause the Sylvester or Schafer Method cannot be applied. It is chiefly used in cases of suffocated children, or when the ribs are badly crushed.

The patient is placed on his back or on one side. Air passages are cleared and the tongue secured in a piece of dry cloth. The lower jaw is depressed to permit unhampered movements of the tongue. The essential movements consist in pulling the tongue forward and holding it out for two seconds, then allowing it to recede into the mouth for two seconds. These movements, repeated 15 times per minute, cause reflex stimulation of the respiratory centre.

Nielsen Method.

This recently developed method has met the approval of many physiologists, including Professor Krogh of Copen-

hagen. It has also been adopted by the Danish Red Cross Society and found to be very efficient. Nielsen claimed that deeper breaths were required for proper cleansing of the lungs.

The patient is placed in the prone position, clothing around the shoulders is removed, tongue pulled forwards, and air passages cleared of any obstruction. The operator kneels astride the patient's head, and exerts the pressure of his hands on the patient's shoulder blades. The operator swings his body forwards, throwing his weight, but no muscular force, onto the patient's shoulders. This is done gradually, so that the pressure is progressive. The pressure movement is continued until the operator's arms are vertical, and the count 4 has been reached. The operator now swings back to release weight, grasping the middle of the patient's upper arms as he does so, and pulls them backwards just enough to lift them slightly, without disturbing the position of patient's head or torso. This second movement is held until the count is continued up to eight.

The operator then assumes his original position and repeats the routine. The entire procedure is repeated 7-8 times per minute, without break in the rhythm. The lifting of the patient's chest permits a much deeper inspiration, and hence a greater lung cleansing action. The Nielsen Method is more difficult to master than the Schafer Method, and has not, as yet, become very popular in this country.

Positive Pressure.

The pulmotor is a German device that was introduced into America about 1908. This machine actually pumps a highly oxygenated air mixture into the lungs under positive pressure, and sucks it out under negative pressure. The action is automatic.

The lungmotor was designed about the same time as the pulmotor, which it closely resembles. It differs from the latter device, however, in that its action is accomplished by hand. A pump resembling an automobile pump is employed.

Both thepulmotor and the lungmotor have been condemned for use in administering artificial respiration. The positive pressure devices do not conform to natural breathing. The excessive pressure and suction cause rupture of the delicate lung tissue, and if the victim is fortunate enough to be revived from the asphyxia, he inevitably dies of lung disease.

The H-H Inhalator.

It has been found that pure oxygen alone tends to retard breathing, whereas, oxygen containing small amounts of carbon dioxide stimulates breathing. Drs. Yandell Henderson and W. Haggard of Yale University, carried out extensive experiments to prove the stimulating action of carbon dioxide. They found that a 93:7 per cent. mixture of oxygen and carbon dioxide was best for resuscitation, especially in cases of carbon monoxide poisoning and ether or alcohol intoxication.

The H-H Inhalator was designed in 1920 by the Mine Safety Appliances Company of Pittsburgh, Pa., to conform with the principles of oxygen-carbon dioxide administration as set forth by Henderson and Haggard. This device consists essentially of a steel cylinder containing 93:7 per cent. mixture of compressed oxygen and carbon dioxide (called carbogen). From the cylinders, the gas mixture is conducted through a reducing valve and a low-pressure regulating valve into a breathing bag. From the bag, the mixture passes through a flexible rubber tube directly to a face mask fitted with inhalation, exhalation and fresh air valves.

The operation of the H-H Inhalator is governed entirely by the respiratory action of the patient himself. It is consequently used in conjunction with a manual method of artificial respiration. The stimulating mixture of gases is drawn in and forced out of the lungs during the inspiratory and expiratory movements of respiration. When the

patient breathes, the carbon dioxide supplied increases the tension of this gas in the lungs. Consequently the percentage of carbon dioxide in the blood increases, which has a direct effect on stimulation of the respiratory center of the medulla. The number and depth of the inspirations increase, and a greater volume of the mixture is required. By regulating the feed valve to the breathing bag, the operator can limit this increase. When the volume is set at fifteen quarts per minute, the patient's respiration is quickly stimulated by the carbon dioxide intake.

If the bag is emptied before the act of inspiration is completed, the fresh air valve in the mask automatically opens and allows air to enter from the outside atmosphere. During expiration, the bag again fills with carbogen, ready for the next inspiration.

In contrast to the use of positive pressure mechanisms, the H-H Inhalator can be operated by a person who has had very little experience with such devices, without danger to the most delicate patient. The Inhalator is packed in a portable case ready to be transported to the scene of the accident. At least three extra carbogen tanks should always be kept on hand. These should be tested regularly to be sure of adequate pressure. Again it is to be noted that *the H-H Inhalator is not used in place of a manual method of artificial respiration, but in conjunction with the manual method.*

Other Mechanical Devices.

A few years ago a mechanical respirator was introduced from France. The patient's chest is placed upon a slightly inclined rest, the legs extended behind. A head rest is provided, and the arms are held up by side saddles. A wide strap attached to the moveable side bars is buckled over the lower ribs. By pushing down a long handle, the side rods are lowered, which lowers the shoulders and puts tension on the strap, which compresses the small of the back, thus bringing about expiration. Upon release of the pressure on the handle, it springs up and allows the ribs to recoil. The shoulders are also lifted up, permitting full expansion of the lungs. The movements of the handle are timed with one's own deep breathing. The H-H Inhalator may be used in connection with the device.

The Drinker Apparatus is a large cabinet, in which the whole body of the patient except the head and neck are enclosed. By reducing the pressure within the chamber, the chest is allowed to dilate owing to air under atmospheric pressure rushing into the lungs through the mouth and nose. Compression of the chest is brought about by natural recoil of the lungs themselves, or a forced expiration may be induced by raising the internal pressure of the chamber by means of a pump. The pump for reducing and restoring the internal pressure of the chamber is operated mechanically. This apparatus is used in large institutions, and many patients, especially children, have been ventilated in this way for long periods of time.

The Carbon Monoxide Hazard.

The hazard of carbon monoxide has grown to be of nation-wide importance, and deserves special mention here. Carbon monoxide is the product of incomplete combustion, and with the present extensive use of gasoline engines for automobiles and trucks, great quantities of this deadly gas are produced. The deadliness of the gas is enhanced by the fact that it has no odour, taste or colour, and it does not give any warning by irritating the mucous membranes of the respiratory passages.

Carbon monoxide acts by uniting chemically with the hæmoglobin of the blood. The hæmoglobin has at least three hundred times more affinity for this gas than for oxygen. Hence within a few minutes' exposure to the gas, the oxygen carrying power of the blood is substantially reduced. Unconsciousness results when the blood is about 50 per cent. saturated with carbon monoxide, and death occurs at about 65 per cent. saturation. A few

breaths of air containing 2 per cent. of carbon monoxide will cause unconsciousness and death within 3-4 minutes. The average carbon monoxide content of black smoke from a burning building is about 0.1 per cent. This percentage is dangerous, particularly during vigorous exertion when the volume of breathing is greatly increased, permitting more rapid saturation of blood with this gas.

If the patient has been exposed for a long time to a comparatively low concentration of carbon monoxide, the blood becomes more thoroughly saturated and a much longer time is required for resuscitation than is the case of patients exposed for shorter periods of time to higher concentrations of the gas. The gas, if not quickly removed, has a destructive effect on the cells of the brain.

In resuscitation of patients asphyxiated with carbon monoxide gas, the administration of a 93:7 per cent. oxygen-carbon dioxide mixture by means of an inhalator is essential. Since the union of carbon monoxide and hæmoglobin is reversible, by mass action of oxygen, the carbon monoxide absorbed may be readily displaced. The carbon dioxide of the inhaled mixture has a stimulating effect on the respiratory movements to permit of greater oxygen intake. Leave the inhalator in action for at least twenty-minutes after normal respirations have been reestablished to permit thorough replacement of the carbon monoxide from the blood.

Training in Artificial Respiration.

Since artificial respiration, to be effective, must be applied immediately the patient is brought to safety, it is obvious that the laymen as well as the medical men must be thoroughly trained in the manual methods of artificial respiration. Time lost in awaiting the arrival of a physician before beginning resuscitation efforts is fatal. It is clearly evident that men, women and children of all walks of life should be trained in some simple, effective method of reviving the asphyxiated.

In Canada, the St. John Ambulance Association and the Royal Life Saving Society offer courses in this important life preserving work to the general public. Employees of such companies as the Bell Telephone Company, the Provincial Gas Company, as well as the many electrical and chemical companies are required to have a thorough practical knowledge of artificial respiration.

In many towns, the police department, the fire department, and the public utilities department, not only train their men in methods of resuscitation, but provide rescue trucks with inhalators and various types of apparatus to be used in answering emergency calls. Many new born babies are saved by the quick response of these employees to the emergency call of a doctor. Since the efficient performance of artificial respiration is developed only through persistent practice, it is the duty of every individual and especially the physician, to keep himself ready at all times to render this vital service to his fellow-men.

Conclusion.

To-day the use of the Schafer Method along with the administration of a 93:7 per cent. mixture of oxygen and carbon dioxide is the most efficient way of applying artificial respiration in the field. The need for further research in this vital question is only too apparent. Those who take part in applying artificial respiration are asked to keep detailed reports of the condition of the patient, reaction to method of resuscitation, length of time inhalator used, etc., and to send them to such workers as Drs. Henderson and Haggard of Yale University, in order that defects in present methods may be detected, and more efficient methods developed.

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MEDICAL ETHICS.

By G. D. TEMPLE, '40.

Although the subject of medical ethics is not strictly our concern as undergraduates, yet it seems worthwhile that we should know, not only that such a subject exists but something of its import and of the influence which it will have upon us in later years. The consideration need not lead to any involved research into its history or development nor even into learning the code as it stands today; rather should it simply make us pause momentarily and reflect upon the manifold obligations and restrictions which the practice of medicine will properly place upon our personal activities.

Ethics, for the purpose of this article at least, might be termed the philosophical treatment of moral conduct, its subject matter being the deliberate, free actions of man. Besides this, the scope of ethics includes whatever has reference to free human acts whether as principle or cause of action (law, conscience, virtue), or as effect or circumstance of action (merit, punishment, etc). The purpose of medical ethics, then, is to investigate what constitutes good or bad, just or unjust, what is conscience, law, virtue, duty, and so forth in the practice of medicine, insofar as they affect or are affected by the moral conduct of the medical practitioner.

It is not certain whether society or the profession itself took the first step in pointing out to medical men that, owing to the fact that they possessed tremendous powers over the lives of those placed in their care, they should have to answer for abuse of that power. It was probably the former. Doubtless, even primitive men observed that doctors' mistakes seldom talked back and that each error usually depleted their ranks by one. At any rate, we find, in the Code of Hammu rabi considerable space devoted to malpractice and the penalties which it might incur. These penalties ranged from confiscation of all or part of the physician's property to confiscation of the physician. Similarly, throughout all history and all societies, ancient and modern, the law, both civil and criminal, has gone to considerable trouble to protect society against negligent and unethical behaviour on the part of physicians and surgeons. Thus, the birth of Oath and Code, although undoubtedly accompanied by the pangs of altruism, was largely assisted by the forceps of public disapproval of malpractice.

The Oath.

The early Greek priest-physicians, the Asclepiades, were, for the most part, men of high moral character, bound together in a brotherhood of blood relationship. When, however, it became necessary, either through shortage of Asclepiades or through increase in patients, to admit into this fraternity those who could not or would not claim descent from the god Aesculapius, it also became necessary to bind these rank outsiders to it and also to impress upon them the high-mindedness of their chosen profession. From all evidence, this was done through the medium of an oath, fragments of which have been found in the Hippocratic writings and attributed to the Father of Medicine. This oath was apparently used extensively in ancient and mediaeval times and comes to us probably altered and adulterated through various translations and through changing times. The earliest extant version of the Hippocratic Oath, the "Christian Oath" is found in a manuscript of the tenth or eleventh century. It is printed in the form of a cross.

FROM THE OATH ACCORDING TO HIPPOCRATES IN SO FAR AS A CHRISTIAN MAY SWEAR IT.

(W. H. S. Jones' translation).

Blessed be God, the Father of our Lord Jesus Christ, who is blessed for ever and ever; I lie not.

I will bring no stain upon the learning of the medical art. Neither will I give poison to anybody though asked to do so, nor will I suggest such a plan. Similarly, I will not give treatment to women to cause abortion, treatment neither from above or below. But I will teach this art, to those who require to learn it, without grudging and without an indenture. I will use treatment to help the sick according to my ability and judgment. .And in purity and in holiness I will guard my art. Into whatsoever houses I enter, I will do so to help the sick keeping myself free from all wrong-doing, intentional or unintentional, tending to death or to injury, and from fornification with bond or free, man or woman. Whatsoever in the course of practice I see or hear (or outside my practice in social intercourse) that ought not to be published abroad, I will not divulge, but consider such things to be holy secrets. Now if I keep this oath and break it not, may God be my helper in my life and art, and may I be honoured among all men for all time. If I keep faith, well; but if I forswear myself, may the opposite befall me."

Nmerous versions of the Hippocratic Oath are still in use to-day in various medical schools throughout the world. Some of these embody all or most of the points laid down in the ancient forms, whilst others bear little resemblance to them. It would appear, however, that this time-honoured ceremony whereby the young medical student swore "to guard my art" is passing away.

Failure of civil authorities to provide legal regulations pertaining to the practice of medicine in Rome led to an intolerable rise of quackery until the situation was cleared by an Imperial edict limiting the number of physicians and stipulating tests of character and ability. The improvement in ethical conduct amongst practitioners was cut short by the fall of the Empire.

During the Middle Ages. the idealistic attitude which the Greeks had held toward the medical art tended to give way to more hedonistic conceptions. More regard was held for profesional etiquette than for professional ethics. The ancient nobility of the profession, however, was carried on in the writings of such men as Paracelsus, Paré, and Sydenham, who tried to extend an "esprit de corps" to all practitioners.

The Code.

In 1803, at the request of many of his colleagues, Thomas Percival, a Manchester physician, published his treatise on "Medical Ethics." It dealt with both medical etiquette, that is, the attitude of members of the profession and medical ethics which concerns the conduct of the physician toward the patient and toward society. Much objection has been made to Percival's Code on the ground that it dealt more with etiquette than with ethics, although certainly the ultimate reason for courteous behaviour between physicians can only be the good of their patients. At any rate a clearly defined code of etiquette was undoubtedly required at that time. It must be remembered that the profession was then divided into three distinct groups: the physicians, scholars and men of high social standing; the surgeons, only a few years removed from the barber's chair and aspiring to higher things; and the apothecaries, the physicians to the poor. Anything which would tend to promote greater harmony between these diverse groups would be bound to reflect favourably upon the patients.

Dealing more specifically with the proper attitude towards the patient, Percival makes many pertinent observations:

"Physicians and surgeons should study also in their deportment, so to unite tenderness with steadiness and condescen-

sion with authority, as to inspire the minds of their patients with gratitude, respect and confidence.

"*The feelings and emotions of the patients under critical circumstances, require to be known and to be attended to, no less than the symptoms of their diseases.*

" . . . *And human nature must be intimately studied to acquire that full ascendancy over the prejudices, the caprices and the passions of the sick, and of their relatives, which is essential to medical success.*

"*Let both the physician and surgeon never forget that their professions are public trusts, properly rendered lucrative whilst they fulfil them; but which they are bound, by honour and probity, to relinquish, as soon as they find themselves unequal to their adequate and faithful execution.*"

Concerning the physician in the treatment of mental disorders, Percival continues: "*Let no one, however, promise himself this divine privilege, if he be not deeply skilled in the philosophy of human nature.*"

Percival also stressed the importance of professional secrecy. He commends temperance for the good of the patient and condemns the dispensing of secret nostrums for the same reason. With regard to the latter he reasons that if the nostrum is of any real benefit it should not be withheld from general usage and if its benefit lies only in its mystery, "such craft implies either disgraceful ignorance, or fraudulent avarice."

With the feeling that Percival's Code was becoming a trifle outdated and possibly also that its precepts were falling somewhat into abeyance, the American Medical Association, in 1847, published its Code of Ethics, a work with considerably less inspiration but rather more authority than its predecessor. This in the main was just the older Code with its face lifted to admit it into newer conditions of practice. In keeping with the true medical spirit, this Code has been revised several times, the latest under the title of "Principles of Medical Ethics of the American Medical Association.,' It consists simply of a series of statements drawn up in a manner suggestive of a legal document but contains little that can be regarded as fundamental truth or settled law of conduct. It is interesting, although we trust not significant, that it devotes four sections to the duties of physicians to their patients, four on the duties of the profession to the public, and thirty-one on the duties of physicians to each other. However, as is pointed out in the conclusion to this Code, these "principles" do not propose to cover the whole field of medical ethics, but they do provide an excellent foundation for more erudite consideration of the subject by those who are interested therein,—which should be every conscientious medical student and practitioner.

It may seem from the necessarily inadequate condensations here presented of the various Codes which have been promulgated for the moral benefit of medical men that there can be little purpose served in learning any code when there may be a new edition out any time now. It is quite true that little purpose is served in learning any one Code in the sense that one learns the relations of the "Lesser Sac," although one should be sufficiently familiar with these more or less dogmatic regulations to be able to refer to them readily whenever the necessary occasion should arise.

What is absolutely essential in any consideration or study of medical ethics or, to be more precise, of ethics as applied to the practice of medicine, is to gain a clear insight into the basic principles behind the rules. In fact the whole system is completely summed up in the injunction: "Therefore all things whatsoever ye would that men should do to you, do ye so to them." It is only because we do not fulfill the requirements of this indenture—requirements which involve justice, mercy, generosity, good faith, much

hope, and great charity—that we need to be bound by Oath and Law and Code. If we could keep before us all our lives and in all circumstances this inspiring command, together with that thrilling first sentence of the Law of Hippocrates, "Medicine is of all the arts the most noble," we should never falter.

It is argued, and with much justification, that we do not practice in a world of saints, unfortunately, but in a world whose Golden Rule is: "Do unto others what they would do unto you—only do it first," and that it is not only impossible to attain that high ethical standard which should be our heritage, but is virtual suicide to attempt it. This contention is readily repudiated by the words of Browning, "Ah, but a man's reach should exceed his grasp, or what's a heaven for?" It must be borne in mind that there is no tribunal to deal with offenders in the realm of ethics, except their own consciences. Unless these are imbued with an inordinately high sense of justice, convictions are likely to be few and sentences very light.

Never forget that medical men seldom view themselves as others see them. They are often so taken up with their own wisdom and their own high theory of morality that they forget that lesser individuals find them less impressive than they seem in their own mirrors. The world is always more willing to see defects than virtues; thus it is far better to concentrate on eliminating the defects than of extolling the virtues of the profession. It is dangerous to climb a ladder with feet of clay.

The eradication of these deficiencies involves much more than simply acquiring greater scientific precision and skill in diagnosis, prognosis and therapeutics. If we always remember that medicine is an art—an art based on science it is true—we shall never forget that something more than fine craftsmanship is necessary; there must be something else which comes from the heart and inspires us to exert all the craft which we have mastered solely for the alleviation of misery or discomfort in one of our fellow-men.

The purpose of this article is to attempt to stress, not the letter but the spirit of ethical medical practice.

The whole spirit of medical ethics is embodied in that beautiful prayer which is usually attributed to Maimonides:

"All-kind Jehovah, thou hast formed the body of man with infinite wisdom. Ten thousand times ten thousand tools Thou hast united within it, and these are increasingly active to maintain the envelope of the immortal soul.

"And thou hast endowed man with wisdom so that he may recognize order and disorder, and so that he may thus relieve the body of ill.

"Thine earth, Thy streams, Thy mountains thou hast blessed with such things as may bring remedy and may mollify the pains of man.

"May the love of my fellow-men and of my art ensoul me.

"Let no thirst for gain or craving for fame take away from my calling.

"Preserve the strength of my body and soul so that I may be always ready to help the rich and the poor, the good and the bad, the enemy as well as the friend. Let me see in the sick the man alone.

"If wiser men wish to teach and correct me, may I follow them and be grateful, for large and wide is the compass of our art.

"In all things make me content, except in the great science of my calling. Let the thought never arise in me that I have attained to enough knowledge, but ever vouchsafe to me willingness to add to what I know.

"Almighty God, Thou hast chosen me in Thy grace to watch over the life and death of Thy creatures. I go now to my labours. Be with me in this great work so that it may avail, for without Thy help nothing succeeds—not even the smallest."

FEATURE SECTION.

The Physician in Germany.

By C. K. Lang, Munich.

I have often been asked about the living conditions of German doctors. In brief reply I would say:

After passing his state examination and completing his compulsory internship (three to five years), the young doctor applies to the "Verband Deutscher Arzte" for the right to practice in a given place. His success depends on the specific necessities of the district. Sometimes his suspense may be long and drawn out, while at others he may commence immediately. This permission also allows him to make claims for treatment of insurance cases. This is quite important in Germany, because 70-80% of the population carry insurance, which in cases of sickness, pay the doctor according to fixed rates. It is evident that without this privilege a German doctor could hardly make his living.

The largest insurance organization is the "Deutsche Arbeiter Versicherung," by which every German laborer is automatically insured. The German civil law demands that these premiums be paid by the employer. Thus the worker in Germany does not have to wonder desperately, "Where can I raise the money to pay the doctor and the hospital?" The insurance answers his question before it is asked; and if he is incapacitated by sickness, the insurance maintains his family. Besides "Arbeiter Versicherung," there is an "Angestellten Versicherung," with which all office workers or other middle class workers must carry insurance. This insurance has higher rates, but permits better care in cases of sickness (better service in hospital, refund on very expensive medicine, etc.). The doctor, too, is more highly paid. Similar to this is the "Deutsche Beamten Versicherung" for all state employees. Finally, there are private insurances, which make insurance possible for all business men, free lances, etc.

Through this system of compulsory insurance, it is possible to prevent serious diseases which would result from delay on the part of the patient in consulting his doctor, because of fear of the expense. As soon as the laborer feels a little under the weather, he goes straight to the physician. For the doctor it is advantageous, not only from the medical point of view, but also financially, since he knows he will get his money and not have to wait years for it.

All policy holders have free choice of doctors, i.e., they may go to those

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doctors whom they consider good. Thus the medical profession in Germany is competitive, so that a good doctor will have more patients and a higher income. Only official doctors or those of a municipal hospital receive regular salaries.

If a young doctor wishes an academic career, he generally stays with a university clinic until he becomes assistant professor, but his income until then is very modest.

In general, the life of a doctor in Germany is much the same as in America, except that he works under rather different conditions.

BOOK REVIEWS

Behind the Doctor.

By Logan Clendening.

As the year rolls on to a hectic conclusion, and even your most interesting text book fails to rouse you from your mental rut, but when you are not yet desperate enough to go to a show, or drown your sorrows, etc., we suggest that you try this book.

Logan Clendening is a medical man of some distinction across the border and not the least of his distinctions is the ability to write with intriguing and amusing interest. Those who recall his Human Body will be able to verify this remark. However, even better is this latest work, which attempts to answer the question, "What is behind the doctor?"

There are so many things behind the doctor that he requires some four hundred odd pages in a very attractively bound and printed volume to describe them. Not one of them is dull. For although he follows the usual chronological method of the medical historian he has an interesting way of putting the facts in narrative dramatic style. For instance we see the dapper, small Dr. Bright of kidney disease fame, enter the wards of Guy's and make his morning rounds. We see young Mr. Addison applying the long, wooden tube of Laennec to the chest of a patient in this clinic and as he does so, "Dr. Bright opened the head of his gold cane and applied it to his nose: it contained some sort of scent, for the condition of the ward and the sick patients was truly a trial to a sensitive olfactory membrane."

Among other yarns he includes those which are indicated in this preface to the book, quoted from the writings of Oliver Wendell Holmes. Medicine learned "from a Jesuit how to cure agues, from a friar how to cut for the stone, from a soldier how to treat the gout, from a sailor how to keep off scurvy, from a postmaster how to sound the Eustachian tube, from a dairymaid how to prevent smallpox, and from an old market-woman how to catch the itch-insect." The stories are brought very much up to date, including an account of the discovery and early use of the anaesthetics. Among other endocrine discoveries he recounts that concerning insulin with more accuracy than does de Kruif in his Men Against Death.

The illustrations are numerous, unusual, and among them is an excellent series depicting the stages in the development of surgery. An excellent bibliography and accurate notation of source and fiction are by no means the least valuable feature of this very valuable book.

If anyone wants to learn a little history, a little medicine, even a little surgery, and at the same time be entertained, we recommend Behind the Doctor.

W.R.F.